EC64-07/08, Part II

IRC R202 (New), N1102.4.2 (New), Table N1102.4.2 (New), N1102.4.3 (New), N1103.6 (New)

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself

PART II – IRC

Add new text and table as follows:

SECTION R202
GENERAL DEFINITIONS

AIR BARRIER. Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material, or a combination of materials.

N1102.4.2 Air sealing and insulation. Building envelop air tightness and insulation installation shall be demonstrated to comply with one of the following options given by Section N1102.4.2.1 or N1102.4.2.2:

N1102.4.2.1 Testing option. Tested air leakage is less than 7 ACH when tested with a blower door at a pressure of 50 pascals. Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed;
2. Dampers shall be closed, but not sealed; including exhaust, intake, makeup air, back draft, and flue dampers;
3. Interior doors shall be open;
4, Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling system(s) shall be turned off;
6. HVAC ducts shall not be sealed; and
7. Supply and return registers shall not be sealed.

2. Visual inspection option: The items listed in Table N1102.4.2, applicable to the method of construction, are field verified. Where required by the code official, an approved party independent from the installer of the insulation, shall inspect the air barrier and insulation.

(Renumber subsequent sections)

TABLE N1102.4.2
AIR BARRIER AND INSULATION INSPECTION

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal insulation is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air permeable insulation is not used as a sealing material.
Ceiling / attic	Air barrier in any dropped ceiling / soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of floor.

COMPONENT	CRITERIA
Crawlspace walls	Insulation is permanently attached to walls. Exposed earth in unvented crawlspaces is covered with class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls, and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by spayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are airtight, IC rated, and sealed to drywall. Exception-- fixtures in conditioned space.
Plumbing and Wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower / tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical / phone box on exterior walls	Air barrier extends behind boxes or air sealed type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

N1102.4.3 Fireplaces. New wood-burning fireplaces shall have gasketed doors and outdoor combustion air.

(Renumber subsequent sections)

Reason: This proposal is intended to reduce the energy lost to infiltration and to improve insulation installation. The details that seal against air infiltration also tend to benefit the thermal integrity of the wall, and vise versa. The energy code requirements for infiltration control have changed little in the last 15 years, except for the addition of recessed lighting specifications. This would be a substantial change that would lead to significant energy savings.

In principal there are no infiltration leaks. Everything is supposed to be sealed. The IECC and IRC both specify "all joints, seams and penetrations", add a list of specific items, and to cover anything that was missed include "other sources of infiltration" are to be "sealed with an air barrier material …" (IECC 402.4.1, IRC N1102.4.1). In practice energy losses from infiltration are large. Infiltration is 16% of the cooling load and 28% of the heating load (2006 Buildings Energy Data Book). Others have higher estimates of infiltration energy loads.

Air infiltration requires air movement. Controlling air means enclosing air, eliminating big holes and paying attention to important details. This proposal includes two methods for showing a home includes at least a moderate level of air control. The first option is a "blower door" test, a house pressurization test with a specified a maximum air leakage. The maximum is 7 ACH50, or 7 Air Changes per Hour at 50 pascals. The ACH50 is a common measurement made where doing air infiltration tests and therefore a reasonable metric for use in the code. ACH50 can be roughly translated into "natural air changes" by dividing by 20. Therefore the 7 ACH50 translated into a natural air change rate of 0.35.

The second option is a visual inspection of many air sealing elements and items that relate to the quality of insulation installation. Most of the items listed in the visual inspection are already in code, this adds a specific requirement to inspect for them as a way of showing compliance with the air-sealing requirement. Two examples of existing requirements specified for inspection in the table-- the 2006 IRC (N1102.4) and IECC (402.4) specify "*The building thermal envelope shall be durably sealed to limit infiltration.*", which covers most of the items in the table. Many items are covered explicitly, either on the list of items in IRC Section N1102.4 and IECC Section 402.4, or explicitly in another section. An example of a section with explicit requirements would be the IECC Section 402.2.5 and IRC Section N1102.2.5 both require insulation to "*maintain permanent contact with the underside of the subfloor.*"

This proposal adds a requirement for better performing fireplaces, including gasketed doors and outside combustion air, both for the energy savings and the indoor air quality. It also adds a definition of "air barrier", principally to make it clear that an air barrier can be a combination of materials, rather

Measured data shows a wide variation in the air tightness of individual homes. The biggest effect of this proposal would be to improve the underperforming half of new homes. (Nevada Study, Page 32; Washington State Study, Page 11; Wisconsin Study, Page 30) A secondary effect would be to improve the air sealing in most homes due to the increased attention to the important areas. Improved air sealing and better insulation installation is also likely to increase comfort, for example decreasing cold spots; and to improve the structures resistance to moisture problems.

The cost for a blower door test varies from about $200 to perhaps $400. The energy savings from reduced infiltration is harder to estimate. As noted already, summaries of infiltration measurements show large variations in the infiltration rates for actual homes, for example a study of infiltration measurements (LBNL study, page 2) showed the standard deviation in "normalized leakage area", which relates directly to infiltration, was almost as big as the mean; therefore bringing the high infiltration homes down to average would be significant by itself. The same study compared conventional new homes to energy efficient new homes and showed that reductions in air leakage of 40-50% are common in energy efficient homes (LBNL study, page 6). Based on the range of infiltration seen in new housing and the large reduction in infiltration in energy efficiency programs, it seems reasonable to estimate that this code change could produce a 20-30% the reduction in air infiltration rates with a similar reduction in energy costs for infiltration.

Bibliography

David Hales. Washington State University Extension Energy Program. December 2001. *Washington State Energy Code Duct Leakage Study Report.* WSUCEEP01105. Olympia, WA.

Michelle Britt, Eric Makela. Britt/Makela Group. June 2003. *Final Report – Volume I, In-Field Residential Energy Code Compliance Assessment and Training Project.* Nevada State Office of Energy.

Scott Pigg and Monica Nevius. Energy Center of Wisconsin. November 2000. *Energy and Housing in Wisconsin: A Study of Single-Family Owner-Occupied Homes Volume 2: Data Book*. Research Report, *199-2*

Max Sherman and Nance Matson. March 2002. *Air Tightness of New U.S. Houses: A Preliminary Report.* LBNL-48671. Lawrence Berkeley National Laboratory (LBNL) Berkeley, CA

US DOE. September 2006. 2006 Buildings Energy Data Book. http://buildingsdatabook.eren.doe.gov/

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: Disapproved

Committee Reason: This proposal would make it extremely difficult or impossible to achieve 7 ACH with a blower door test after rough in. The issue of air quality needs to be considered. The test method is not stated. The visual option would require returning to the site 5 or 6 times or obtain a third party and would be added expense for the local jurisdiction.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Craig Conner, Building Quality, representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE N1102.4.2,
AIR BARRIER AND INSULATION INSPECTION

Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with the building envelope air barrier.

Remainder of table is unchanged.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: *Jurisdictions legitimately expect the I-codes to be an internally consistent family of model codes that they can use as the foundation for their own building code. This change is one of a series of changes intended to correct a large number of inconsistencies in the residential energy requirements in the IECC and IRC. Greater detail is provided in the reason statements for EC6 and RE6.*

EC64 alignment: EC64 was Approved as Modified in the IECC and Disapproved in IRC. To realign the two codes, EC64 in the IRC should be Approved as Modified by the IECC committee.

EC64 content: EC64 adds requirements for air sealing and quality of insulation installation. It requires residences to be tested for air tightness test or have a visual inspection for a list of items. This represents a moderate beginning towards achieving energy savings from improved air sealing and better installation of insulation. The energy efficiency available from improved air sealing and better installation of insulation is more than is available through increased R-value. Incremental quality is more important and incremental quantity.

In principal air sealing and proper installation of insulation is required in code; however, in practice these are not effectively implemented.

EC64 requires gasketed fireplace doors and external combustion air for fireplaces. US Department of Energy states that a traditional *"fireplace is one of the most inefficient heat sources you can possibly use."*[1] The California Energy Commission agrees that *"Traditional fireplaces are an energy loser - it's best not to use them because they pull heated air out of the house and up the chimney."* Gasketed doors and external combustion air will greatly improve fireplace performance.

1 http://www1.eere.energy.gov/consumer/tips/fireplaces.html
2 http://www.consumerenergycenter.org/tips/winter.html

Public Comment 2:

Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Steven Rosenstock, Edison Electric Institute, Harry Misuriello, American Council for Energy Efficient Economy, request Approval as Modified by this Public Comment.

Modify proposal as follows:

SECTION R202
GENERAL DEFINITIONS

AIR BARRIER. Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material, or a combination of materials.

N1102.4.2 Air sealing and insulation. Building envelope air tightness and insulation installation shall be demonstrated to comply with ~~one of~~ the following ~~options given~~ requirements established by Section N1102.4.2.1 ~~or~~ and N1102.4.2.2:

N1102.4.2.1 Performance ~~T~~testing ~~option~~. Building envelope tightness ~~and insulation installation~~ shall be ~~considered acceptable when~~ tested to have an air leakage ~~is~~ less than 0.00036 SLA ~~7 ACH~~ when tested with a blower door at a pressure of 50 pascals (0.2 inch w.g.). Testing shall occur any time after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances and sealing thereof. Where required by the code official, an approved party independent from the builder shall conduct the building envelope tightness test. A written test report showing compliance shall be provided to the code official.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed;
2. Dampers shall be closed, but not sealed; including exhaust, intake, makeup air, back draft, and flue dampers;
3. Interior doors connecting conditioned spaces shall be open; doors connecting to unconditioned spaces closed but not sealed;
4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling system(s) shall be turned off;
6. HVAC duct s systems shall ~~not~~ be sealed~~;~~ and ~~7. S~~supply and return registers shall not be sealed.

402.4.2.2 Visual inspection requirement. ~~option:~~ Building envelope ~~tightness and~~ insulation installation shall be ~~considered acceptable when the items listed in Table N1102.4.2, applicable to the method of construction, are~~ field verified to meet the criteria in Table N1102.4.2. Where required by the code official, an approved party independent from the builder and the installer of the insulation, shall inspect ~~the air barrier and~~ insulation; in such case, a written inspection report, including a checklist demonstrating compliance shall be provided to the code official before interior finish materials are applied.

(Renumber subsequent sections)

TABLE N1102.4.2
~~AIR BARRIER AND~~ INSULATION INSPECTION

COMPONENT	CRITERIA
~~Air barrier and t~~Thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. ~~Breaks or joints in the air barrier are filled or repaired.~~ ~~Air permeable insulation is not used as a sealing material.~~ ~~Air permeable insulation is inside of an air barrier.~~
Ceiling / attic	Air barrier in any dropped ceiling / soffit is substantially aligned with insulation ~~and any gaps are sealed~~. ~~Attic access (except unvented attic), knee wall door, or drop down stair is sealed.~~
Walls	Corners and headers are insulated. ~~Junction of foundation and sill plate is sealed.~~
~~Windows and doors~~	~~Space between window/door jambs and framing is sealed.~~
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. ~~Air barrier is installed at any exposed edge of insulation.~~
Crawlspace walls	Insulation is permanently attached to walls. ~~Exposed earth in unvented crawlspaces is covered with class I vapor retarder with overlapping joints taped.~~
~~Shafts, penetrations~~	~~Duct shafts, utility penetrations, knee walls, and flue shafts opening to exterior or unconditioned space are sealed.~~
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by spayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are airtight, IC rated, and sealed to drywall. ~~Exception--fixtures in conditioned space.~~
Plumbing and Wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower / tub on exterior wall	Showers and tubs on exterior walls have insulation ~~and an air barrier separating them from the exterior wall~~.
~~Electrical / phone box on exterior walls~~	~~Air barrier extends behind boxes or an air sealed type boxes are installed.~~
~~Common wall~~	~~Air barrier is installed in common wall between dwelling units.~~
~~HVAC register boots~~	~~HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.~~
~~Fireplace~~	~~Fireplace walls include an air barrier.~~

N1102.4.3 Fireplaces. New wood-burning fireplaces shall have gasketed doors and outdoor combustion air.

(Renumber subsequent sections)

Commenter's Reason: Properly controlling air leakage and properly installing insulation are both critical to achieve more energy savings in homes. In particular, reasonable control of air leakage can have an enormous positive effect on building energy efficiency. Since the builder is already required to properly install insulation and seal the building, the only true incremental cost is the cost of testing and inspection. This cost is fairly small compared to the benefits of proper sealing and insulation of the home.

EC64 as written (and modified by the IECC Code Development Committee) improves existing code language by setting out clear steps for inspection and offers a testing option for air leakage. EC64 is an improvement over the existing code and the EECC supported it before the IECC Code Development Committee, in lieu of our own air leakage/sealing proposal.

However, we are submitting this public comment with a proposed modification because we believe that this proposal can be substantially improved. For example, while the testing option as written will address air leakage, it does not address proper insulation installation. On the other hand, the inspection option does not guarantee reduced air leakage; the only way to guarantee it is to require testing.

In order to address these important issues, the proposed modification does the following:

1. Makes both testing (with a written report) and a more limited visual inspection required;
2. Permits the code official to require independent testing and inspection with written reports;
3. Reduces the burden on code officials by reducing their inspection requirements by eliminating those requirements no longer necessary as a result of the test;
4. Allows the infiltration testing to be done “any time after rough in” to alleviate concerns about timing of sealing holes and infiltration testing.
5. Makes the infiltration testing units consistent with other infiltration units in the IECC with Specific Leakage Area (SLA) and improves the testing protocol; and
6. Removes the exception for recessed lights that penetrate into spaces that can be interpreted as “conditioned”, such as spaces between the ceiling and floor.

These changes will make this code change more enforceable and an improvement in energy efficiency over the language in the original proposal.

Public Comment 3:

Ronald Majette, U.S. Department of Energy, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

SECTION R202
GENERAL DEFINITIONS

~~**AIR BARRIER.** Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material, or a combination of materials.~~

N1102.4.2 Air sealing testing~~**and insulation.**~~ ~~Building envelop air tightness and insulation installation shall be demonstrated to comply with one of the following options given by Section N1102.4.2.1 or N1102.4.2.2:~~

~~**N1102.4.2.1 Testing option.**~~ Building envelope tightness ~~and insulation installation~~ shall be ~~considered acceptable when tested air leakage is~~ less than <u>or equal to</u> 7 ACH when tested ~~with a blower door~~ at a pressure of 50 pascals. Testing shall occur <u>any time</u> after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed~~, but not sealed~~;
2. Dampers shall be closed~~, but not sealed~~; including exhaust, intake, makeup air, back draft, and flue dampers;
3. Interior doors shall be open;
4, Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed ~~and sealed~~;
5. Heating and cooling system(s) shall be turned off<u>; and</u>
6. ~~HVAC ducts shall not be sealed; and~~
~~7.~~ supply and return registers shall <u>be open</u>~~not be sealed~~.

~~**N1102.4.2.2 Visual inspection option:** Building envelope tightness and insulation installation shall be considered acceptable when the items listed in Table N1102.4.2, applicable to the method of construction, are field verified. Where required by the code official, an approved party independent from the installer of the insulation, shall inspect the air barrier and insulation.~~

~~TABLE N1102.4.2~~
~~AIR BARRIER AND INSULATION INSPECTION~~

~~**COMPONENT**~~	~~**CRITERIA**~~
~~Air barrier and thermal barrier~~	~~Exterior thermal insulation is installed in substantial contact and continuous alignment with building envelope air barrier.~~ ~~Breaks or joints in the air barrier are filled or repaired.~~ ~~Air permeable insulation is not used as a sealing material.~~ ~~Air permeable insulation is inside of an air barrier.~~
~~Ceiling / attic~~	~~Air barrier in any dropped ceiling / soffit is substantially aligned with insulation and any gaps are sealed.~~ ~~Attic access (except unvented attic), knee wall door, or drop down stair is sealed.~~
~~Walls~~	~~Corners and headers are insulated.~~ ~~Junction of foundation and sill plate is sealed.~~
~~Windows and doors~~	~~Space between window/door jambs and framing is sealed.~~
~~Rim joists~~	~~Rim joists are insulated and include an air barrier.~~
~~Floors (including above garage and cantilevered floors)~~	~~Insulation is installed to maintain permanent contact with underside of subfloor decking.~~ ~~Air barrier is installed at any exposed edge of insulation.~~
~~Crawlspace walls~~	~~Insulation is permanently attached to walls.~~ ~~Exposed earth in unvented crawlspaces is covered with class I vapor retarder with overlapping joints taped.~~
~~Shafts, penetrations~~	~~Duct shafts, utility penetrations, knee walls, and flue shafts opening to exterior or unconditioned space are sealed.~~
~~Narrow cavities~~	~~Batts in narrow cavities are cut to fit, or narrow cavities are filled by spayed/blown insulation.~~
~~Garage separation~~	~~Air sealing is provided between the garage and conditioned spaces.~~
~~Recessed lighting~~	~~Recessed light fixtures are airtight, IC rated, and sealed to drywall.~~ ~~Exception--fixtures in conditioned space.~~
~~Plumbing and Wiring~~	~~Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.~~
~~Shower / tub on exterior wall~~	~~Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.~~
~~Electrical / phone box on exterior walls~~	~~Air barrier extends behind boxes or an air sealed type boxes are installed.~~
~~Common wall~~	~~Air barrier is installed in common wall between dwelling units.~~
~~HVAC register boots~~	~~HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.~~
~~Fireplace~~	~~Fireplace walls include an air barrier.~~

N1102.4.3 Fireplaces. New wood-burning fireplaces shall have gasketed doors and outdoor combustion air.

N1103.7 Ventilation fans. Bathrooms and kitchens shall be provided with ventilation that meets the requirements of Section M1507.3. Alternately, the code official may approve other means of ventilation.

Commenter's Reason: This proposal is intended to reduce the energy lost to infiltration and to improve insulation installation. The energy code requirements for infiltration control have changed little in the last 15 years, except for the addition of recessed lighting specifications. This would be a substantial change that would lead to significant energy savings.

This proposal differs from the original proposal approved by the IECC committee by deleting the visual inspection option and requiring pressure testing of the building envelope. It is difficult to impossible to accurately check for all sources of potential leakage by visual inspection. Pressure testing is the only way to ensure an adequate level of sealing.

The proposal addresses all the reasons for disapproval provided by the IRC committee:
"*This proposal would make it extremely difficult or impossible to achieve 7 ACH with a blower door test after rough in*". The proposal clarifies that the test can occur any time after rough in. Once the house is completed and all penetrations are sealed, the 7 ACH rate is not only possible, but is very reasonable. "*The issue of air quality needs to be addressed.*" The proposal now requires kitchen and bathroom ventilation as specified in the IRC. "The test method is not stated". We believe the test method is adequately specified. "Blower door" envelope pressure tests have been widely used in Energy Star Homes for many years. "*The visual option would require returning to the site 5 or 6 times or obtain a third party and would be added expense for the local jurisdiction.*" The revision of the original proposal deletes the visual inspection option. The envelope pressurization test only needs to occur once.

In principal there are no infiltration leaks. Everything is supposed to be sealed. The IECC and IRC both say "all joints, seams and penetrations", add a list of items, and to cover anything that was missed include "other sources of infiltration" are to be "sealed with an air barrier material …" (IECC 402.4.1, IRC N1102.4.1). In practice energy losses from infiltration are large. Infiltration is 16% of the cooling load and 28% of the heating load (2006 Buildings Energy Data Book). Others have higher estimates.

Air infiltration requires air movement. Controlling air means enclosing air, eliminating big holes and paying attention to important details. This proposal requires a "blower door" test, a house pressurization test with a specified a maximum air leakage. The maximum is 7 ACH50, or 7 Air Changes per Hour at 50 pascals. The ACH50 is a common measurement made where doing air infiltration tests and therefore a reasonable metric for use in the code. ACH50 can be roughly translated into "natural air changes" by dividing by 20. Therefore the 7 ACH50 translated into a natural air change rate of 0.35.

This proposal retains proposed requires approved by the IECC committee for better performing fireplaces, including gasketed doors and outside combustion air, both for the energy savings and the indoor air quality. It also retains specifies kitchen and bathroom ventilation fans specified in the IRC for air quality.

Measured data shows a wide variation in the air tightness of individual homes. The biggest effect of this proposal would be to improve the underperforming half of new homes. (Nevada Study, Page 32; Washington State Study, Page 11; Wisconsin Study, Page 30) A secondary effect would be to improve the air sealing in most homes due to the increased attention to the important areas. Improved air sealing and better insulation installation is also likely to increase comfort, for example decreasing cold spots; and to improve the structures resistance to moisture problems.

The cost for a blower door test varies from about $200 to perhaps $400. The energy savings from reduced infiltration is harder to estimate. As noted already, summaries of infiltration measurements show large variations in the infiltration rates for actual homes, for example a study of infiltration measurements (LBNL study, page 2) showed the standard deviation in "normalized leakage area", which relates directly to infiltration, was almost as big as the mean; therefore bringing the high infiltration homes down to average would be significant. The same study compared conventional new homes to energy efficient new homes and showed that reductions in air leakage of 40-50% are common in energy efficient homes (LBNL study, page 6). Based on the range of infiltration seen in new housing and the large reduction in infiltration in energy efficiency programs, it seems reasonable to estimate that this code change might produce a 10-30% the reduction in air infiltration rates with a similar reduction in energy costs for infiltration.

References:
David Hales. Washington State University Extension Energy Program. December 2001. *Washington State Energy Code Duct Leakage Study Report.* WSUCEEP01105. Olympia, WA.
Michelle Britt, Eric Makela. Britt/Makela Group. June 2003. *Final Report – Volume I, In-Field Residential Energy Code Compliance Assessment and Training Project.* Nevada State Office of Energy.
Scott Pigg and Monica Nevius. Energy Center of Wisconsin. November 2000. *Energy and Housing in Wisconsin: A Study of Single-Family Owner-Occupied Homes Volume 2: Data Book*. Research Report, *199-2*
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US DOE. September 2006. 2006 Buildings Energy Data Book.
http://buildingsdatabook.eren.doe.gov/

Final Action: AS AM AMPC____ D

EC65-07/08, Part I
402.4.3, 502.4.7

NOTE: PART II DID NOT RECEIVE A PUBLIC COMMENT AND IS ON THE CONSENT AGENDA. PART II IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY FOLLOWING ALL OF PART I.

Proposed Change as Submitted:

Proponent: Lawrence Brown, CBO, National Association of Home Builders (NAHB)

PART I – IECC

Revise as follows:

402.4.3 (Supp) Recessed lighting. Recessed luminaires ~~installed in~~ that penetrate the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces, ~~All Recessed luminaires~~ and shall be ~~IC-rated and~~ labeled as meeting ASTM E 283 when tested at 1.57 psi (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. Recessed luminaires in contact with insulation shall be listed and labeled as IC-rated. ~~All Recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.~~

502.4.7 (Supp) Recessed lighting. Recessed luminaires ~~installed in~~ that penetrate the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces, ~~All Recessed luminaires~~ and shall be ~~IC-rated and~~ labeled as meeting ASTM E 283 when tested at 1.57 psi (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. Recessed luminaires in contact with insulation shall be listed and labeled as IC-rated. ~~All Recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.~~

Reason: To provide consistency between the IECC and the IRC for luminaries that penetrate the building thermal envelope.

Cost Impact: The code change proposal will increase the cost of construction.

PART I – IECC
Committee Action: **Disapproved**

Committee Reason: The committee believed that the language of the standard could be construed to mean that no IC rating is required for cans that penetrate the ceiling membrane.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Lawrence Brown, CBO, National Association of Home Builders, requests Approval as Submitted.

Commenter's Reason: Simply, the purpose of this Proposal is to reword the text to provide clear and enforceable language as to the application of this provision for the installation of "ALL" recessed lighting fixtures. The reason the wording of the original text stood out to me is because I started out in this business as an electrical inspector. Looking at the Code Committee's statement that, *"The committee believed that the language of the standard could be construed to mean that no IC rating is required for cans that penetrate the ceiling membrane."* goes directly to the reason for the need of the rewording. The second sentence of this provision states that "All Recessed luminaires and shall be IC-rated…" Those who work in the energy arena need to understand the difference between an IC rated fixture and a NON-IC rated fixture. Most importantly, the "IC" rating has nothing to do with energy conservation. It is a concern of the electrical installation.

If a light fixture is intended for direct contact with insulation, it requires an IC rating (IC stands for Insulated Contact). An IC rated fixture must be approved for zero clearance insulation cover by a NRTL such as Underwriters Laboratory. If a light fixture is to be installed in a space that does not contain insulation, a NON-IC rated fixture can be used (NON-IC stands for NON Insulated Contact). Though, if insulation is present in an application where a NON-IC rated fixture is used, a minimum 3" clearance is required between all sides of the fixture, and no insulation may be present across the top of the installed fixture. By maintaining these clearance requirements, overheating should not be an issue according to testing conducted on the fixture.

As currently written, this provision requires an IC rated fixture, even in those interior ceilings and walls where insulation contact is not a consideration. If you look closely at the changes shown in the original proposal, the application of recessed fixtures that "penetrate" the thermal envelope will still need to comply with the stated requirements of ASTM E 283. Furthermore, the proposed change clearly points out that only those recesses fixtures in contact with insulation will need to be IC rated, the same as is required by the NEC.

Final Action: AS AM AMPC____ D

NOTE: PART II REPRODUCED FOR INFORMATIONAL PURPOSES ONLY – SEE ABOVE

EC65-07/08, PART II – IRC BUILDING/ENERGY

Revise as follows:

N1102.4.3 Recessed lighting. Recessed luminaires ~~installed in~~ <u>that penetrate</u> the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces, ~~by being:~~ <u>and shall be labeled as meeting ASTM E 283 when tested at 1.57 psi (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. Recessed luminaires in contact with insulation shall be listed and labeled as IC-rated.</u>

1. ~~IC-rated and labeled with enclosures that are sealed or gasketed to prevent air leakage to the ceiling cavity or unconditioned space; or~~
2. ~~IC-rated and labeled as meeting ASTM E 283 when tested at 1.57 pounds per square foot (75 Pa) pressure differential with no more than 2.0 cubic feet per minute (0.944 L/s) of air movement from the conditioned space to the ceiling cavity; or~~
3. ~~Located inside an airtight sealed box with clearances of at least 0.5 inch (13 mm) from combustible material and 3 inches (76 mm) from insulation.~~

Reason: (Same as Part I)

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC **Withdrawn by Proponent**

EC66-07/08
402.6

Proposed Change as Submitted:

Proponent: Lawrence Brown, CBO, National Association of Home Builders (NAHB); Craig Conner, Building Quality, representing himself; William E. Koffel, PE, Koffel Associates, Inc., representing the Glazing Industry Code Committee; Vickie J. Lovell, InterCode Incorporated, representing the Association of Industrial Metallized Coaters and Laminators

Delete without substitution:

~~**402.6 Maximum fenestration *U*-factor and SHGC. (Mandatory).** The area weighted average maximum fenestration *U*-factor permitted using trade offs from Section 402.1.4 or Section 404 shall be 0.48 in zones 4 and 5 and 0.40 in zones 6 through 8 for vertical fenestration, and 0.75 in zones 4 through 8 for skylights. The area weighted average maximum fenestration SHGC permitted using trade-offs from Section 404 in Zones 1 through 3 shall be 0.50.~~

Reason (Brown): Limits on fenestration U-factor and SHGC tradeoffs restrict ways by which code compliance can be achieved. By definition, trade-offs are energy neutral, and do not save energy, so this section is not necessary.

Cost Impact (Brown): Potential cost savings.

Reason (Conner): This section should be deleted because it has proven to be confusing, limits flexibility, and does not save energy. A similar code change passed the IRC committee in the last code cycle.

This section confuses most code users who often interpret it as another prescriptive code requirement comparable to the more stringent prescriptive U-factor in Tables 402.1.1 and 402.1.3. I have found this requirement very hard to explain and agree with the IRC committee that the code would be better if it relied only on the U-factor and SHGC requirements in the main requirements table.

The original intent of this section was to eliminate condensation-prone windows in cold climates. The market is already eliminating condensation-prone windows.

Some common products, such as glass block and garden windows, never meet these "hard limits." In principle, a calculation or exemption would be required if more than a small area of these common products are used in new residences. Additions or renovations with significant areas of these glazing products would be technically illegal unless they include other glazing products, even when the addition or renovation includes increased efficiency such as improved HVAC efficiency or increased insulation levels.

Cost Impact (Conner): The code change proposal will not increase the cost of construction.

Reason (Koffel): The IECC is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve the effective use of energy. The sections proposed for deletion not only limit flexibility, they are confusing and do not save energy. Section N1102.5.1 of the *International Residential* Code was recommended for deletion by the committee and passed by the members during the last code cycle.

It should be noted that the performance design still requires one to demonstrate that annual energy cost that is less than or equal to the annual energy cost of the standard reference design. A true performance approach should not contain limits unless the limits can be justified as being something that cannot be truly evaluated using the performance approach. It should be noted that the ICC Performance Code for Buildings and Facilities does not contain such limits with respect to energy efficiency or any other provision. The current limits are similar to saying that one may use the performance code provided the building is still protected with an automatic sprinkler system.

Cost Impact (Koffel): The code change proposal will not increase the cost of construction and in fact may decrease the cost of construction by providing additional options.

Reason (Lovell): The U-factor and SHGC cap for fenestration has been deleted in the 2007 Supplement to the International Residential Code. Eliminating this provision in the code has simplified the process for demonstrating compliance and in doing so allowed more flexibility in the UA trade-off approach. Unfortunately this artificial cap continues to exist in the International Energy Conservation Code. Those that argue that the cap is needed claim that builders will install inefficient windows in new homes if this cap is not in place yet they have offered no technical support for this argument. Also, the envelope provisions in the 2006 IECC have made it very difficult to trade-off non-low E glazing U-factors in Climate Zones 4 and above. Eliminating the glass area restriction from the IECC has put the emphasis on fenestration U-factor which typically requires the code user to install a Low E window even using U.S. DOE's REScheck software or a Section 404 performance based approach.

Those who argue in favor of the window efficiency minimums claim that an unlimited amount of glazing can be installed in any building therefore certain minimums must be put in place. Technically under Section 404, this assumption is incorrect because a proposed building with greater than or equal to 18% glass to floor area is now compared to a base case building with 18% glass, making the high glass building more difficult to comply and essentially placing an energy penalty on these types of buildings.

As with window U-factor, the primary housing markets in Climate Zones 1- 3 are already using low SHGC windows. For example, housing markets in Southern Nevada, Arizona and Texas have been routinely installed Low E windows to meet the 0.40 SHGC requirements of the 2003 IECC. This artificial SHGC requirement will have no impact on these markets.

Currently under the 2006 IECC, fenestration SHGC and U-factor are the only two features that have restrictions. Trade-offs are allowed for all other building envelope features under the Total UA Alternative or the Simulated Performance Alternative even though reduced levels of insulation in building assemblies will affect the performance of the building. Even California's Title 24 Energy Code allows unlimited trade-offs with glazing features under the performance based compliance approach. It is important to note that when a proposal was brought before the IECC Code Development Committee during the 2004/2005 Cycle that would have placed mandatory minimums on insulation levels, it was disapproved. One of the reasons for disapproval was that "it would somewhat circumvent the trade off procedure and the simulated performance methods."

Section 402.6 is the remaining confusing provision in an energy code that was drastically simplified in the 2006 version. The language, as currently in the code, is unenforceable. One must first determine what the term "area weighted average maximum" means and then determine how to apply this to their design. Separate calculation(s) will then need to be conducted for both the UA trade off approach and also performance based approach to ensure that the SHGC and U-factor caps are met for both vertical fenestration and skylights.

Finally, this confusing, unenforceable provision restricts product choices for use in the field – which is in conflict with Section 101.3, the intent of the IECC. The impacts of this provision directly eliminates the use of glazed block as the only window type in small additions in several climate zones, rather than to "provide flexibility and to permit the use of innovative approaches and techniques". Fenestration products, such as glazed block with a U-factor of 0.60 cannot be used in Climate Zones 4 and above as the sole window in a small addition such as a bathroom unless other windows are installed to meet the weighted average maximum limits.

Cost Impact (Lovell): The code change proposal will not increase the cost of construction.

Committee Action: Approved as Submitted

Committee Reason: The present code language is confusing and it does not allow flexibility in the choice of materials in the thermal envelope.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Steven Rosenstock, Edison Electric Institute, Harry Misuriello, American Council for Energy Efficient Economy, requests Disapproval.

Commenter's Reason: EC66 should be disapproved. The glazing trade-off maximums currently found in Section 402.6 of the *IECC* are simple mandatory measures that ensure that all new homes contain high-quality, cost-effective windows that save energy, resist condensation in colder climates and block unwanted solar gain in warmer climates. EC66 would take a substantial step backward in energy efficiency by removing these protections entirely. Without the protection of section 402.6, glazing values could be traded away to levels unacceptable in modern building practice. For example, without the maximums, cold, uncomfortable windows with high condensation (including even single pane windows) could be used in colder climates and windows with no solar protection could be used in hot climates. Given our nation's high priority for energy efficiency and the low cost (if any) of achieving these maximum values, it is imperative that Section 402.6 remain as currently written in the *IECC*.

It should be noted that these mandatory maximum values are above the prescriptive values in the code and are, by definition, cost effective. Even the proponents of EC66 do not claim that these requirements fail a cost-benefit test – instead, they claim that the requirements may not be necessary because the market may achieve the same results without them, and that these maximums limit flexibility and are confusing. These claims are not well-supported and are refuted by actual experience.

First, the ability of the market to produce a house that will meet minimum code requirements does not justify the elimination of code requirements. In fact, it reinforces the value of having such code requirements in the first place. For example, now that all new homes contain fire alarms, should that requirement be eliminated from the code? The code plays an important role in shaping the market, and essential provisions should be maintained even when most of the market comes into compliance. If, as the proponents suggest, the market already produces homes that meet the fenestration requirement 100%, then there can be no legitimate argument for removing the maximums.

Second, the current glazing maximums are effective and easy to understand. These requirements have been successfully applied for the past few years. All states that have already adopted the 2004 or 2006 *IECC* have adopted these maximums without amendment. They are also already seamlessly built into compliance software such as the Department of Energy's REScheck. Compliance could not be simpler.

Third, the area-weighted average approach embodied in Section 402.6 allows considerable flexibility for builders to install decorative glass, glass block, and other fenestration products, while maintaining a baseline performance for the home's overall glazing. In short, not all products need to individually meet the maximum values, only the area weighted average of all products in the home is required to meet the maximum. Thus, there is substantial room and flexibility for the builder to utilize products that are exceptions. The caps are modest numbers that are achievable by most glazing products currently on the market in each climate zone. The *IECC* currently employs a number of other mandatory measures (including a mandatory maximum fenestration air leakage number) to ensure that the minimum code house is reasonably constructed – Section 402.6 is no different.

The maximums are a key safety net and homeowner protection in a code that allows unlimited glazing area in the Prescriptive and Total UA compliance paths (indeed, the adoption of the maximums in the first place was in part a response to the elimination of glazing restrictions in 2004). Since the 2004 *IECC*, these compliance paths no longer tie the glazing area to the home's overall energy efficiency requirements. Instead, the *IECC* takes a component-based approach and allows envelope-based trade-offs within certain guidelines. EC66 removes the most important restriction on fenestration trade-offs, and substantially increases the risk that a new home will be built with substandard windows to the long-term detriment of the homeowner. Given the cost of replacement windows, this is not an easy failure to remedy after the fact. EC66 provides no basis for concluding that elimination of the maximums without reintroducing glazing limits will not increase energy use.

Fenestration maximums first appeared in the 2004 version of the *IECC/IRC*, and have been repeatedly challenged and repeatedly upheld by the *IECC* Committee and the ICC in public comment. Even this time, in a complete reversal of previous actions, the *IECC* Committee was split evenly, 7-7, with the chair casting the deciding vote. The Committee only cited a claim that the code language is "confusing and does not allow flexibility …." As noted above, these claims are not valid. In upholding and retaining Section 402.6 in previous code cycles, the Committee stated:

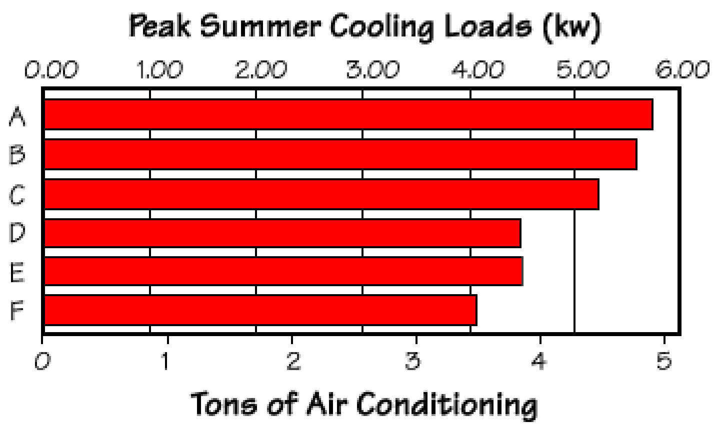
2006/07 (EC58 and EC59) – "Therefore, the limits are needed to assure that other factors created by windows, such as moisture condensation and creation of hot spots do not cause a need to adjust the thermostat a great degree."
2004/05 (EC36) – "There is concern with removing the SHGC requirements in the warmer climate zones. The committee also supported keeping these values because the performance path can be used to accept other values and products which may not be possible under the prescriptive path. This limitation was placed in the IECC to help offset the fact that the window area limitations were eliminated by EC48-03/04 in the last code cycle.

Since this would bring about a radical change in the code, and would risk significant losses in energy efficiency nationwide, we believe that the fenestration maximums should remain in the code -- the proponents of EC66 simply cannot and do not justify this significant departure from the current code.

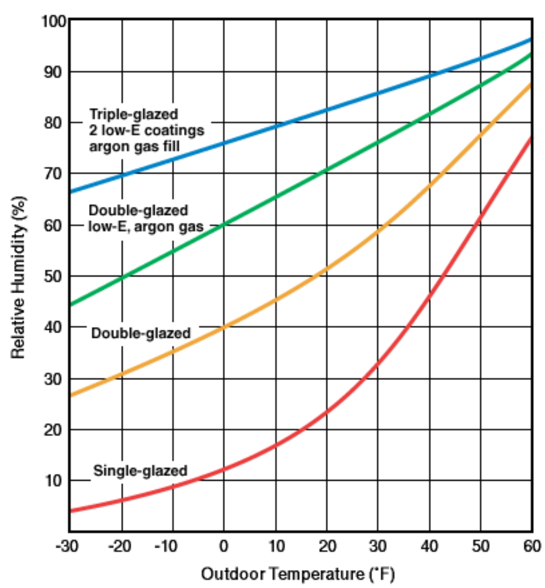
Benefits of Retaining Section 402.6 Fenestration Maximums:

1. **Quality Windows, Energy Savings and Peak Demand Savings Nationwide**. The fenestration maximums encourage the use of cost-effective low-e windows nationwide. Efficient windows bring immediate cost savings to the builder who can downsize heating and cooling equipment, and bring long-term energy savings, greater comfort and reduced condensation for consumers. On a larger scale, because low-SHGC windows reduce energy consumption during the peak summer months in warmer climates, and low U-Factor windows reduce energy consumption during peak heating months in colder climates, high-quality windows can help reduce the strain on the electric grid and delay the need to build peak generation. They will also reduce the need for natural gas and help to reduce the amount of oil that is imported. Consumers also enjoy the reduced costs that come with economies of scale and market transformation. By avoiding extreme trade-offs of windows with resulting long-term detriment, fenestration maximums are a critical part of a well-functioning energy code.

The following chart, developed by the U.S. Department of Energy's Lawrence Berkley National Laboratory (LBNL), which is found on the Efficient Window Collaborative (EWC) website (www.efficientwindows.org), shows the potential for saving peak demand for different window types. Window F is the low SHGC, low U-factor window that would satisfy the window maximums across the country (by contrast, window A is a single pane window). As is readily apparent, improved windows are crucial to lower peak cooling loads and smaller HVAC sizes (with lower costs).



2. **Improved Condensation Resistance.** Window condensation and the associated problems are a function of the window's U-factor, the indoor relative humidity, and the outside temperature. Glass with a lower U-factor maintains a higher room-side temperature, which means the glass can withstand lower exterior temperatures and more interior humidity without attracting condensation. Glass with a high U-factor will succumb to condensation much more easily. The following chart also provided by LBNL on the EWC website shows the condensation potential for different window types.

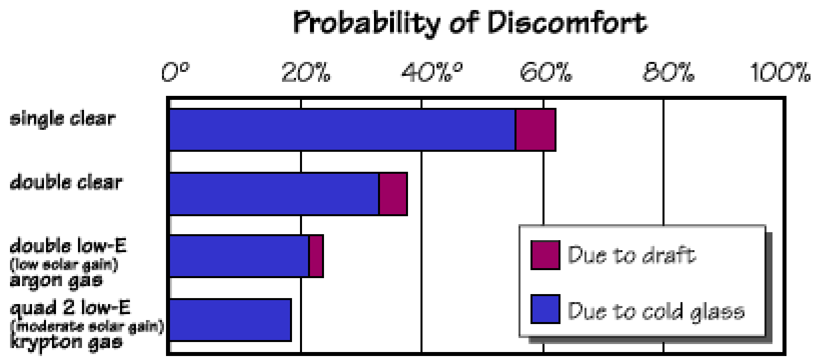


Note: Condensation occurs above the lines for each product type

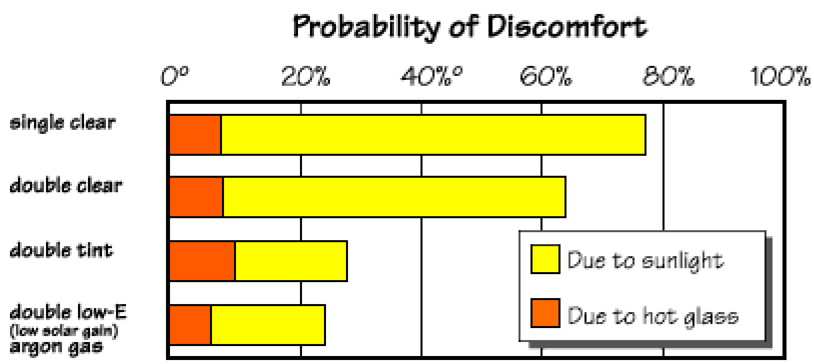
According to the chart, a typical double-glazed low-e window can withstand a 0 degree outdoor temperature and 60% relative humidity inside before condensation will begin to collect. By contrast, a regular double-glazed window can only withstand 40% humidity at the same outdoor temperature. In other words, a low-e window has a 50% more effective ability to resist condensation. A single-glazed low e window is far worse – it can withstand less than 15% humidity at the same temperature – a virtual guarantee of damaging condensation. The fenestration maximums substantially reduce the likelihood of condensation in the colder months, enhancing durability and long-term benefits for the homeowner.

3. **More Comfortable Homes and Less Energy Use.** The energy code revolves around occupant comfort -- any perceived energy savings will be instantly lost if an occupant is uncomfortable and adjusts the thermostat. Incremental changes in window efficiency can have a disproportionate impact on occupant comfort because even the most efficient windows are, at best, still only the equivalent of an R-3 wall. Hot spots created by high solar gain in the summer and cold or drafty glass in the winter months can force an occupant to adjust the thermostat to compensate (which will increase cooling and heating bills at a time when natural gas costs about $1.20 per therm on the wholesale market and heating oil costs over $3.60 per gallon wholesale). The charts below, again produced by LBNL and displayed on the EWC website, show that occupant discomfort can double or triple, depending on the type of glass installed.

   For example, the following chart shows the probability of discomfort during winter from poorer windows ranging from over 60% with single clear and almost 40% with double clear. This risk declines to almost 20% with a low-e window as specified by Section 402.6. This problem is due to the cold window -- at zero degrees outdoors, the single pane glass is less than 20 degrees on the inside surface, the double clear glass is slightly over 40 degrees, while the low e glass is approaching 60 degrees. Obviously, the warmer the interior glass surface, the less likelihood of discomfort.



Similarly, the following chart shows the probability of discomfort during summer from sunlight and hot glass. The potential comfort problem from bad windows is even worse in the summer. The summertime probability of discomfort ranges from almost 80% with single clear and over 60% with double clear declining to almost 20% with windows as specified by Section 402.6.



In heating-dominated climates, a good low-e window will keep occupants more comfortable during the coldest months. In cooling-dominated climates, windows with low SHGC will protect against hot spots and occupant discomfort, and will make it less likely that occupants will need to adjust the thermostat and use more energy.

4. **Conclusion.** As shown above, the fenestration maximums serve an important role in ensuring residential energy efficiency. We recommend that EC66 be rejected for the obvious negative impact it would have on the energy efficiency and quality of new homes.

Final Action: AS AM AMPC____ D

EC67-07/08

403, 403.1, 403.1.1, 403.2.2, 403.2.3, 403.3, 403.4, 403.5, 403.6, 404.2, Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Ronald Majette, U.S. Department of Energy

Revise as follows:

SECTION 403
SYSTEMS ~~(Mandatory)~~

403.1 Controls. **(Mandatory)** At least one thermostat shall be provided for each separate heating and cooling system.

403.1.1 Heat pump supplementary heat. **(Mandatory)** Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

403.2.2 Sealing. **(Mandatory)** All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3 of the *International Residential Code*.

403.2.3 Building cavities. **(Mandatory)** Building framing cavities shall not be used as supply ducts.

403.3 Mechanical system piping insulation. **(Mandatory)** Mechanical system piping capable of carrying fluids above 105°F (41°C) or below 55°F (13°C) shall be insulated to a minimum of R-2.

403.4 Circulating hot water systems. **(Mandatory)** All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

403.5 Mechanical ventilation. **(Mandatory)** Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

403.6 Equipment sizing. **(Mandatory)** Heating and cooling equipment shall be sized in accordance with Section M1401.3 of the *International Residential Code.*

404.2 Mandatory Requirements. Compliance with this section requires that the mandatory provisions identified in Section 401.2 ~~criteria of Section 401, 402.4, 402.5, 402.6, and 403~~ be met. All supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-4.

TABLE 404.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Thermal distribution systems	A thermal distribution system efficiency (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies. Duct insulation: From Section 403.2.1.	Same as standard reference design, except as specified by Table 404.5.2(2).

(Portion of table and footnotes not shown remain unchanged)

Reason: The purpose of this code change is to allow duct insulation to be reduced to R-4 in the simulated performance path. The current code requires either R-6 or R-8 duct insulation with no possibility for trade-offs. R-4 is a more reasonable mandatory minimum value.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: **Approved as Modified**

Modify the proposal as follows:

401.2 Compliance. Projects shall comply with Sections 401, 402.4, 402.5, 402.6 and ~~403~~ 403.1, 403.2.2, 403.2.3, and 403.3 through 403.6 (referred to as the mandatory provisions) and either:

1. Sections 402.1 through 402.3, 403.2.1, and 404.1 (prescriptive); or
2. Section ~~404~~ 405 (performance).

403.2.1 Insulation. (Supp) (Prescriptive) Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

404.2 Mandatory Requirements. Compliance with this section requires that the mandatory provisions identified in Section 401.2 be met. All supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of ~~R-4~~ R-6.

Committee Reason: The primary modification to the original proposal was to require a minimum insulation of R-6, instead of the proposed R-4. The committee agreed with the proponent that a minimum amount of insulation should be specified for the performance path. However, given that, in the prescriptive path the minimum insulation specified is R-6, the committee was more comfortable with R-6 as opposed to R-4.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Larry Williams, Steel Framing Alliance, requests Disapproval.

Commenter's Reason: The IECC committee approved this as modified. It unnecessarily places restrictions on the use of the simulated performance alternative option permitted under Section 404 of the code. Section 404 is intended to allow flexibility in meeting the code and this proposal takes away some of that flexibility. If this is indeed a performance option, then it should set an overall standard for compliance and not place arbitrary and unnecessary restrictions on the user of this section of the code. It also complicates the code in terms of enforcement and design when one considers the many other proposals approved by the committee that place further restriction on the performance option.

A better solution would be to modify the end score required by the simulations than to try to implement piecemeal changes with unknown impact on the overall building's performance.

Final Action: AS AM AMPC____ D

EC68-07/08, Part I

403.1.1 (New)

Proposed Change as Submitted:

Proponent: Thomas D. Culp, Ph.D., Birch Point Consulting LLC

PART I – IECC

Add new text as follows:

403.1.1 Programmable thermostat. At least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55ºF (13ºC) or up to 85ºF (29ºC). The thermostat shall initially be programmed with a heating temperature set point no higher than 70ºF (21ºC) and a cooling temperature set point no lower than 78ºF (26ºC).

(Renumber subsequent sections)

Reason: This proposal adds a new requirement in residential buildings to provide a programmable thermostat with scheduling and setback capabilities. These thermostats are now commonplace at any home store. A typical programmable thermostat will add between $20-$40 over the cost of manual thermostats. The U.S. EPA Energy Star website promotes that when used properly, programmable thermostats can save about $150/year in energy costs. Even if the actual savings are only a fraction of that amount, the payback period is very short. This proposal also specifies that the thermostat be initially programmed with heating and cooling temperature set points consistent with the Energy Star program.

Cost Impact: The code change proposal will increase the cost of construction.

PART I – IECC
Committee Action: Approved as Modified

Modify proposal as follows:

403.1.1 Programmable thermostat. Where the primary heating system is a forced air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55ºF (13ºC) or up to 85ºF (29ºC). The thermostat shall initially be programmed with a heating temperature set point no higher than 70ºF (21ºC) and a cooling temperature set point no lower than 78ºF (26ºC).

(Renumber subsequent sections)

Committee Reason: Programmable thermostats represent a good opportunity for energy savings. The modification limits the requirement to forced air furnaces because the application of this type of requirement is practical with this type of equipment.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Shaunna Mozingo, City of Westminster, CO, representing the Colorado Chapter of the International Code Council, requests Disapproval.

Commenter's Reason: Colorado Chapter requests disapproval of Part I. EC68 Part II 07/08 was disapproved by the IRC B/E committee.

The results of the Palm Springs hearings have established Chapter 4 of the IECC and Chapter 11 of the IRC as two separate, distinct sets of minimum standards for the same structure, while the physical dynamics are the same in both.

Divergent actions on this item will lead to confusion and inconsistency in code enforcement and construction. Conflicting requirements devalue the benefits of the IRC as an effective stand alone document. When the differences are justified based on technical merit, we can all readily provide a reasonable explanation and achieve code compliance.

This is one of a series of public comments attempting to bring consistency back to the family of I-codes.

Public Comment 2:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The cost of programmable thermostats varies from $30 to as much as $250 or more, depending on the desired features. Models that are designed for heat pumps are more expensive due to the need for more complicated controls. Conventional programmable thermostats are not compatible with heat pumps. When a heat pump is in its heating mode, setting back a conventional heat pump thermostat can cause the unit to operate inefficiently, thereby canceling out any savings achieved by lowering the temperature setting.

A programmable thermostat will not allow properly sized equipment to recover from a summertime set-up, or winter set-back (quick cool/heat). Most programmable thermostats are not pre-programmed and only adds confusion for older adults that do not know how to program a thermostat. Clock type thermostats would not be effective for individuals that work different shift s sometimes called swing shifts where heating and cooling would be utilized on different schedules each week. This often leads to excessive energy usage rather than conservation and would defeat the intentions of this proposal.

Final Action: AS AM AMPC____ D

EC68-07/08, Part II
IRC N1103.1.1 (New)

Proposed Change as Submitted:

Proponent: Thomas D. Culp, Ph.D., Birch Point Consulting LLC

PART II – IRC

Add new text as follows:

<u>**N1103.1.1 Programmable thermostat.** At least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55ºF (13ºC) or up to 85ºF (29ºC). The thermostat shall initially be programmed with a heating temperature set point no higher than 70ºF (21ºC) and a cooling temperature set point no lower than 78ºF (26ºC).</u>

(Renumber subsequent sections)

Reason: This proposal adds a new requirement in residential buildings to provide a programmable thermostat with scheduling and setback capabilities. These thermostats are now commonplace at any home store. A typical programmable thermostat will add between $20-$40 over the cost of manual thermostats. The U.S. EPA Energy Star website promotes that when used properly, programmable thermostats can save about $150/year in energy costs. Even if the actual savings are only a fraction of that amount, the payback period is very short. This proposal also specifies that the thermostat be initially programmed with heating and cooling temperature set points consistent with the Energy Star program.

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: **Disapproved**

Committee Reason: There is no documented evidence that programmable thermostats save energy.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Craig Conner, Building Quality, representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

N1103.1.1 Programmable thermostat. <u>Where the primary heating system is a forced air furnace,</u> at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).

Commenter's Reason: *Jurisdictions legitimately expect the I-codes to be an internally consistent family of model codes that they can use as the foundation for their own building code. This change is one of a series of changes intended to correct a large number of inconsistencies in the residential energy requirements in the IECC and IRC. Greater detail is provided in the reason statements for EC6 and RE6.*

EC68 alignment: EC68 was Approved as Modified in the IECC, but Disapproved in the IRC. <u>To realign the two codes, EC68 in the IRC could be Approved as Modified by the IECC committee</u>.

EC68 content: EC68 requires a programmable thermostat, which the IECC committee limited to forced-air furnaces. This change places the same requirement into the IRC.

Public Comment 2:

Thomas D. Culp, Birch Point Consulting LLC, representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

N1103.1.1 Programmable thermostat. <u>Where the primary heating system is a fossil fuel forced air furnace,</u> ~~A~~<u>a</u>t least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).

Commenter's Reason: The IRC code committee correctly pointed out that standard programmable thermostats can sometimes cause problems when used with heat pumps and hydronic systems. Therefore, this modification would limit the requirement to only forced air furnaces, where programmable thermostats are most practical and beneficial. This modification would be consistent with part I as approved by the IECC committee.

Final Action: AS AM AMPC____ D

EC69-07/08, Part I

202, 403.2 (New)

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself

PART I – IECC

Add new text as follows:

SECTION 202
GENERAL DEFINITIONS

<u>**FURNACE ELECTRICITY RATIO.** The ratio of furnace electricity use to total furnace energy computed as ratio = $(3.412*E_{AE})/(1000*E_F + 3.412*E_{AE})$, where E_{AE} (average annual auxiliary electrical consumption) and E_F (average annual fuel energy consumption) are defined in Appendix N to subpart B of part 430 of title 10 of the Code of Federal Regulations and E_F is expressed in millions of Btus per year.</u>

<u>**403.2 Furnace electricity ratio.** Where not prohibited by Federal law, the furnace electricity ratio shall not be greater than 2%.</u>

(Renumber subsequent sections)

Reason: Residential furnaces use blowers to distribute warm air. The blower motors account for most of fossil-fuel furnace electricity consumption. Currently, no minimum efficiency requirement exists for furnace electricity use. In some cases, the furnace blower is the largest consumer of electricity in the household. Substantial cost-effective electricity savings are available from using efficient blower motors already in use in some furnaces.

DOE has the authority to regulate furnace electricity; however, DOE chose not regulate furnace blower motors or at least to delay regulation until an unspecified date in its recent furnace efficiency rulemaking. Although Federal law (NAECA) regulates residential heating equipment efficiency, the law allows states and regions to petition DOE for a waiver to set higher requirements. Some states and regions are moving towards higher efficiency requirements for electrical use in furnaces, usually based on the requirement presented here.

Currently most furnace blowers use a permanent split capacitor (PSC) motor. The efficiency level proposed here would probably be achieved by switching to a brushless permanent magnet (BPM) motor also called an electronically-commutated motor (ECM). Furnaces with the higher level of efficiency and the BPM motor are available in the market today.

A simple payback can be estimated from DOE's rulemaking. DOE's recent furnace rulemaking estimated an annual energy savings of about 215 kwh per year (DOE TSD page 8.5-6), or about $21.5 per year for a BPM at $0.10/kwh. DOE estimates the cost of the new fan at about $213 (TSD page 6.4-2), perhaps decreasing by about 78% (TSD page 8.5-2) to about $166 by 2012 for mature market costs. The simple payback would be about 8 years in the mature market.

Estimated savings from other studies have been higher. Four other studies are cited in <u>BPM Motors in Residential Gas Furnaces: What are the Savings?</u>. Based on the cited estimates of savings the simple payback would be 3 to 8 years.

It should be noted that the "furnace electricity ratio" specified in this proposal is based solely on efficiency information already provided by the manufacturers.

Adoption and use of this proposal would promote significant electricity savings. Inclusion of this change in the IECC/IRC would encourage states and regions that do get a waiver to use the same requirement; thereby, creating a large market for furnaces with high efficiency blowers.

Bibliography:
BPM Motors in Residential Gas Furnaces: What are the Savings? *James Lutz, Victor Franco, Alex Lekov, and Gabrielle Wong-Parodi. Lawrence Berkeley National Laboratory, Berkeley, California.* LBNL-59866
DOE's Federal Register Notice dated October 6, 2006. 10 CFR Part 430, *Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces and Boilers; Proposed Rule*, and its technical support document (TSD) available at: http://www.eere.energy.gov/buildings/appliance_standards/residential/furnaces_boilers_1113_r.html
Consumers' Directory of Certified Efficiency Ratings. Gas Appliance Manufacture's Association..
http://www.gamanet.org/gama/inforesources.nsf/vContentEntries/Furnace+electrical+efficiency?OpenDocument

Cost Impact: The code change proposal will increase the cost of construction.

PART I – IECC
Committee Action: Approved as Modified

Modify proposal as follows:

403.2 Furnace electricity ratio. Where not prohibited by Federal law, ~~the~~ fossil fuel furnaces shall have a furnace electricity ratio ~~shall~~ not ~~be~~ greater than 2% and shall include a manufacturer's designation of the furnace electricity ratio.

(Renumber subsequent sections)

(Portions of proposal not shown remain unchanged)

Committee Reason: This is a feasible and practical requirement that is in use in many areas. The modification simply stipulates that the manufacturer provide the furnace electricity ratio.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Patrick A. McLaughlin, McLaughlin & Associates, representing The Air-Conditioning, Heating and Refrigeration Institute, requests Disapproval.

Commenter's Reason: AHRI requests that this proposal, to establish a maximum furnace electricity ratio, be disapproved because the National Appliance Energy Conservation Act (NAECA) preempts, and the proponent acknowledges the preemption. Congress stated when enacting NAECA; "The purpose of S.83 is to reduce the Nation's consumption of energy and to reduce the regulatory and economic burdens on the appliance manufacturing industry through the establishment of national energy conservation standard for major residential appliances." Furthermore, the Energy Independence and Security Act of 2007 specifically direct the Department of Energy to prescribe an efficiency standard for the electricity used by furnaces.

Federal law does allow states to petition DOE for waivers but it is very difficult to get a waiver; in fact, there are none. Therefore, if this proposal is approved, the requirement cannot be enforced. The intent of the ICC system is to provide uniform regulations nationwide, yet this proposals intent is to use the Code to encourage variation from federal law and non-uniform requirements.

If the preemption is ignored, note that there are no implementation dates in the proposal, thus the requirements would be effective on the day that each local jurisdiction adopts the code and receives its waiver. For obvious reasons, any proposal of this nature requires phased implementation.

The code change should be disapproved because the subject is preempted by NAECA and the proposal will create confusion for enforcers, consumers and manufactures.

The proposal was disapproved by the IRC RE Committee.

Public Comment 2:

Shaunna Mozingo, City of Westminster, CO, representing the Colorado Chapter of the International Code Council, requests Disapproval.

Commenter's Reason: The Colorado Chapter requests disapproval of Part I. EC69 Part II 07/08 was disapproved by the IRC B/E committee.

The results of the Palm Springs hearings have established Chapter 4 of the IECC and Chapter 11 of the IRC as two separate, distinct sets of minimum standards for the same structure, while the physical dynamics are the same in both.

Divergent actions on this item will lead to confusion and inconsistency in code enforcement and construction. Conflicting requirements devalue the benefits of the IRC as an effective stand alone document. When the differences are justified based on technical merit, we can all readily provide a reasonable explanation and achieve code compliance.

This is one of a series of public comments attempting to bring consistency back to the family of I-codes.

Public Comment 3:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The furnace electricity ratio is a specification that needs to be covered under Federal law along with SEER and AFUE. This requirement should not be within the purview of the energy code. This is ahead of what the HVAC industry and DOE is doing and DOE is intending to address this situation. This is a manufacturing issue and the code should not dictate how manufacturers build appliances. This is outside the scope of this code.

Public Comment 4:

Ted A. Williams, American Gas Association, requests Disapproval.

Commenter's Reason: The reason for disapproval by the IRC Committee (by a vote of 11 to 0) is correct. Federal law preempts setting of standards on the products covered by the proposal. ICC should not promulgate requirements that are in conflict with federal preemption requirements. To do so would make state adoption of the IECC impossible without a parallel approval of federal exemption from preemption. The U. S. Department of Energy (DOE) has an active agenda for rulemaking covering the subject matter of the proposal in which the proponent's proposed technical change can be addressed. The proponent should be encouraged to put the proposal forward there and not within the IECC. The IECC Committee needs to reconsider its understanding of the federal preemption language as stated at the Palm Springs hearings and seek guidance from ICC generally on how these requirements relate to IECC proposals. The ICC membership needs to assess the IECC Committee vote in context of this issue and disapprove the proposal.

Final Action: AS AM AMPC____ D

EC69-07/08, Part II

IRC R202, N1103.2

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself

PART II – IRC

Add new text as follows:

SECTION R202
GENERAL DEFINITIONS

FURNACE ELECTRICITY RATIO. The ratio of furnace electricity use to total furnace energy computed as ratio = $(3.412*E_{AE})/(1000*E_F + 3.412*E_{AE})$, where E_{AE} (average annual auxiliary electrical consumption) and E_F (average annual fuel energy consumption) are defined in Appendix N to subpart B of part 430 of title 10 of the Code of Federal Regulations and E_F is expressed in millions of Btus per year.

N1103.2 Furnace electricity ratio. Where not prohibited by Federal law, the furnace electricity ratio shall not be greater than 2%.

(Renumber subsequent sections)

Reason: Residential furnaces use blowers to distribute warm air. The blower motors account for most of fossil-fuel furnace electricity consumption. Currently, no minimum efficiency requirement exists for furnace electricity use. In some cases, the furnace blower is the largest consumer of electricity in the household. Substantial cost-effective electricity savings are available from using efficient blower motors already in use in some furnaces.

DOE has the authority to regulate furnace electricity; however, DOE chose not regulate furnace blower motors or at least to delay regulation until an unspecified date in its recent furnace efficiency rulemaking. Although Federal law (NAECA) regulates residential heating equipment efficiency, the law allows states and regions to petition DOE for a waiver to set higher requirements. Some states and regions are moving towards higher efficiency requirements for electrical use in furnaces, usually based on the requirement presented here.

Currently most furnace blowers use a permanent split capacitor (PSC) motor. The efficiency level proposed here would probably be achieved by switching to a brushless permanent magnet (BPM) motor also called an electronically-commutated motor (ECM). Furnaces with the higher level of efficiency and the BPM motor are available in the market today.

A simple payback can be estimated from DOE's rulemaking. DOE's recent furnace rulemaking estimated an annual energy savings of about 215 kwh per year (DOE TSD page 8.5-6), or about $21.5 per year for a BPM at $0.10/kwh. DOE estimates the cost of the new fan at about $213 (TSD page 6.4-2), perhaps decreasing by about 78% (TSD page 8.5-2) to about $166 by 2012 for mature market costs. The simple payback would be about 8 years in the mature market.

Estimated savings from other studies have been higher. Four other studies are cited in BPM Motors in Residential Gas Furnaces: What are the Savings? . Based on the cited estimates of savings the simple payback would be 3 to 8 years.

It should be noted that the "furnace electricity ratio" specified in this proposal is based solely on efficiency information already provided by the manufacturers.

Adoption and use of this proposal would promote significant electricity savings. Inclusion of this change in the IECC/IRC would encourage states and regions that do get a waiver to use the same requirement; thereby, creating a large market for furnaces with high efficiency blowers.

Bibliography:

BPM Motors in Residential Gas Furnaces: What are the Savings? *James Lutz, Victor Franco, Alex Lekov, and Gabrielle Wong-Parodi. Lawrence Berkeley National Laboratory, Berkeley, California.* LBNL-59866

DOE's Federal Register Notice dated October 6, 2006. 10 CFR Part 430, *Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces and Boilers; Proposed Rule*, and its technical support document (TSD) available at: http://www.eere.energy.gov/buildings/appliance_standards/residential/furnaces_boilers_1113_r.html

Consumers' Directory of Certified Efficiency Ratings. Gas Appliance Manufacture's Association.. http://www.gamanet.org/gama/inforesources.nsf/vContentEntries/Furnace+electrical+efficiency?OpenDocument

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: Disapproved

Committee Reason: This proposal is premature. It is ahead of what industry and DOE is doing. This is a manufacturing issue and the code should not dictate how manufacturer build appliances. This is not clear that it applies only to fossil-fuel fired furnaces. This would add a requirement that can only apply if a Federal Law authorizes it.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Craig Conner, Building Quality, representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

N1103.2 Furnace electricity ratio. Where not prohibited by Federal law, fossil-fuel ~~the~~ furnaces shall have a furnace electricity ratio ~~shall~~ not ~~be~~ greater than 2% and shall include a manufacturer's designation of the furnace electricity ratio.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: *Jurisdictions legitimately expect the I-codes to be an internally consistent family of model codes that they can use as the foundation for their own building code. This change is one of a series of changes intended to correct a large number of inconsistencies in the residential energy requirements in the IECC and IRC. Greater detail is provided in the reason statements for EC6 and RE6.*

EC69 alignment: EC69 was Approved as Modified in the IECC and Disapproved in the IRC. To realign the two codes, EC69 for the IRC should be Approved as Modified by the IECC committee.

EC69 content: EC69 requires a higher efficiency furnace blower. Inefficient furnace fans can consume a substantial amount of electricity.

The IRC committee commented that, *"it is not clear that it applies only to fossil-fuel furnaces."* The IECC committee's modification clarifies that the requirement applies only to fossil-fuel furnaces.

The IRC committee held that, *"This proposal is premature."* However, the IECC committee seemed to disagree. Testimony noted that several states are actively pursuing this exact requirement for efficient furnace blowers. Other evidence of current availability and use is found in the industry. Since December 2004 the Gas Appliance Manufacturers Association has noted what it calls "electrically efficient furnaces"--furnaces that meet this exact requirement in their *Consumers' Directory of Certified Efficiency Ratings*. A look at the most recent 2008 guide shows over 1000 units that meet this criterion. As the IECC committee commented when it approved this change, it is "*feasible and practical*" and "*is in use in many areas.*"

[1] March 31, 2008 at http://www.ahrinet.org/Content/ResidentialFurnace_592.aspx

Final Action: AS AM AMPC____ D

EC70-07/08, Part I
403.2.2

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself

PART I – IECC

Revise as follows:

403.2.2 Sealing. All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3 of the *International Residential Code*

Air handlers with a manufacturer's designation for an air leakage of no more than 2 percent of the design air flow rate when tested at an air pressure of 1-inch water gauge when all air inlets, air outlets, and condensate drain port(s) are sealed shall be deemed sealed. Air handlers with filter boxes shall be tested with the filter box in place.

Reason: The 2006 IECC and IRC already require sealed air handlers. Requiring sealed air handlers offers, but does not require, one method for demonstrating what is "sealed." Under the existing code it is difficult for either a builder or inspector to know if an air handler is "sealed." This proposal adds an option based on a measurement that originated in Florida to verify that an air handler is sealed, a measurement that is already being used by several manufacturers. Air handlers that are sealed, tested, and labeled by the manufacturer as "sealed in the factory" provide a practical way to verify code compliance in the field.

This change was approved for the IECC during the last code cycle but disapproved in the final action hearing. The main argument against this change was that manufacturers could not meet the requirement and that few or perhaps no "air-tight" air handlers were available on the market, which is incorrect. Many manufactures are producing sealed air handlers using the specification proposed here. Examples of available products that can be verified on the web include those listed below. Other manufacturers also produce air handlers that meet this requirement.

Amana- Three product lines use this test and meet this requirement. Product specifications for AEPF, ASPF, ARPF (1½ to 5 ton) state the following,

> "*Complies with the Factory-sealed Air Handling Credit as listed in the 2001 Florida Building Code, Chapter 13, Section 610.2.A.2.1.*"
> "*Factory-sealed to achieve 2% or less leakage rate with or without field-installed filter kits at 1.0" water gauge external duct static pressure*."

http://www.amana-hac.com/Home/Products/AirHandlers/tabid/292/Default.aspx
http://www.amana-hac.com/Portals/1/pdf/SS-AAEPF.pdf
http://www.amana-hac.com/Portals/1/pdf/SS-AASPF.pdf
http://www.amana-hac.com/Portals/1/pdf/SS-AARPF.pdf

Goodman**-** Three product lines use this test and meet this requirement. Product specifications for AEPF, ASPF, ARPF (1½ to 5 ton) state the following:

> *"Complies with the Factory-sealed Air Handling Credit with or without field-installed filter kits as listed in the 2001 Florida Building Code, Chapter 13, Section 610.2.A.2.1."*
> *"Factory-sealed to achieve 2% or less leakage rate with or without field-installed filter kits at 1.0" water gauge external duct static pressure."*

http://www.goodmanmfg.com/Home/Products/AirHandlers/tabid/262/Default.aspx
http://www.goodmanmfg.com/Portals/0/pdf/SS-GAEPF.pdf
http://www.goodmanmfg.com/Portals/0/pdf/SS-GASPF.pdf
http://www.goodmanmfg.com/Portals/0/pdf/SS-GARPF.pdf

Lennox- Two product lines use this test and meet this requirement. Product specifications for
Merit® Series CBX26UH/CB26UH-R and Elite® Series CBX27UH/CB27UH air handlers state the following:

> *"Meets Florida standards for less than 2% air leakage from unit."*

http://www.lennox.com/products/list.asp?type=8
http://www.lennox.com/products/overview.asp?model=CBX26UH
http://www.lennox.com/products/overview.asp?model=CBX27UH

Cost Impact: The code change proposal will not increase the cost of construction.

PART I – IECC
Committee Action: **Approved as Submitted**

Committee Reason: This proposal provides a useful and practical method for checking for adequate sealing of air handling equipment.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Patrick A. McLaughlin, McLaughlin & Associates, representing The Air-Conditioning, Heating and Refrigeration Institute, requests Disapproval.

Commenter's Reason: The proposed code change should be disapproved because of technical and editorial flaws:

1. This is exactly the same proposal that was disapproved by the membership last cycle. Nothing has changed other than ASHRAE has commenced the project to develop a standard.
2. There is no established test methodology to qualify air handlers to determine compliance. It is premature to require a level of performance without establishing the testing criteria to gauge the performance. To that end ASHRAE is developing a Standard, SP 193, Method of Testing for Determining the Air Leakage Rate of HVAC Equipment, to provide "a method of testing forced-air heating and cooling equipment for air leakage". This proposal should not go forward until that standard is complete.
3. The language, as proposed, is not a code requirement. The section currently requires that ducts, air handlers, filter boxes and building cavities used as duct be sealed. The proposed code change adds a leakage rate criterion for air handlers as an example when an air handler might be considered sealed. Specifically, it states that if the criteria is met the handler shall be "deemed" sealed. As written it could still be sealed if it doesn't meet the criteria. This will create confusion within the industry, builders and the enforcement community.
4. The proponent implies in his reason statement that these products are common in the industry. This is not the case, especially for furnaces. The products do exist but they account for few of the 10,000 different models currently on the market.
5. The requirements should not be approved because it is not justified. The leakage rate, which is found in the Florida Building Code, is not a code requirement. The 2 percent leakage rate is only mentioned for residential as a credit factor for Method A performance calculations. And it was developed from a very limited study of only 69 units of which 60 were heat pumps and only 9 forced air furnaces. It is not reasonable to establish a national requirement on air leakage for all air handlers based on 9 forced air furnaces.

Disapprove the proposal because of the lack of a standard, confusion on enforcement and the absence of technical justification. The proposal was disapproved by the IRC RE Committee.

Public Comment 2:

Shaunna Mozingo, City of Westminster, CO, representing the Colorado Chapter of the International Code Council, requests Disapproval.

Commenter's Reason: The Colorado Chapter requests disapproval of Part I. EC70 Part II 07/08 was disapproved by the IRC B/E committee.

The results of the Palm Springs hearings have established Chapter 4 of the IECC and Chapter 11 of the IRC as two separate, distinct sets of minimum standards for the same structure, while the physical dynamics are the same in both.

Divergent actions on this item will lead to confusion and inconsistency in code enforcement and construction. Conflicting requirements devalue the benefits of the IRC as an effective stand alone document. When the differences are justified based on technical merit, we can all readily provide a reasonable explanation and achieve code compliance.

This is one of a series of public comments attempting to bring consistency back to the family of I-codes.

Public Comment 3:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: There currently is no consensus standard on how to test for leakage in an air handler. Does every unit need to be tested, by reading the proposal it appears as if they do. Currently ASHRAE has a proposed standard 193P that will most likely be published for the next code cycle. NAHB recommends waiting until the testing standard is in place before requiring testing for leakage.

Public Comment 4:

Ted A. Williams, American Gas Association, requests Disapproval.

Commenter's Reason: The reason for disapproval by the IRC Committee is correct. The ICC membership needs to consider the Committee Reason for disapproval offered by the IRC Committee (i.e., lack of a consensus standard covering method of test) and consider that the IECC Committee did not address this deficiency.

Final Action: AS AM AMPC____ D

EC70-07/08, Part II
IRC N1103.2.2

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself

PART II – IRC

Revise as follows:

N1103.2.2 Sealing. Ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3.

<u>Air handlers with a manufacturer's designation for an air leakage of no more than 2 percent of the design air flow rate when tested at an air pressure of 1-inch water gauge when all air inlets, air outlets, and condensate drain port(s) are sealed shall be deemed sealed. Air handlers with filter boxes shall be tested with the filter box in place.</u>

Reason: The 2006 IECC and IRC already require sealed air handlers. Requiring sealed air handlers offers, but does not require, one method for demonstrating what is "sealed." Under the existing code it is difficult for either a builder or inspector to know if an air handler is "sealed." This proposal adds an option based on a measurement that originated in Florida to verify that an air handler is sealed, a measurement that is already being used by several manufacturers. Air handlers that are sealed, tested, and labeled by the manufacturer as "sealed in the factory" provide a practical way to verify code compliance in the field.

This change was approved for the IECC during the last code cycle but disapproved in the final action hearing. The main argument against this change was that manufacturers could not meet the requirement and that few or perhaps no "air-tight" air handlers were available on the market, which is incorrect. Many manufactures are producing sealed air handlers using the specification proposed here. Examples of available products that can be verified on the web include those listed below. Other manufacturers also produce air handlers that meet this requirement.

<u>Amana</u>- Three product lines use this test and meet this requirement. Product specifications for AEPF, ASPF, ARPF (1½ to 5 ton) state the following,

> "*Complies with the Factory-sealed Air Handling Credit as listed in the 2001 Florida Building Code, Chapter 13, Section 610.2.A.2.1*."
> "*Factory-sealed to achieve 2% or less leakage rate with or without field-installed filter kits at 1.0" water gauge external duct static pressure*."

http://www.amana-hac.com/Home/Products/AirHandlers/tabid/292/Default.aspx
http://www.amana-hac.com/Portals/1/pdf/SS-AAEPF.pdf
http://www.amana-hac.com/Portals/1/pdf/SS-AASPF.pdf
http://www.amana-hac.com/Portals/1/pdf/SS-AARPF.pdf

<u>Goodman</u>**-** Three product lines use this test and meet this requirement. Product specifications for AEPF, ASPF, ARPF (1½ to 5 ton) state the following:

> *"Complies with the Factory-sealed Air Handling Credit with or without field-installed filter kits as listed in the 2001 Florida Building Code, Chapter 13, Section 610.2.A.2.1."*
> *"Factory-sealed to achieve 2% or less leakage rate with or without field-installed filter kits at 1.0" water gauge external duct static pressure."*

http://www.goodmanmfg.com/Home/Products/AirHandlers/tabid/262/Default.aspx
http://www.goodmanmfg.com/Portals/0/pdf/SS-GAEPF.pdf
http://www.goodmanmfg.com/Portals/0/pdf/SS-GASPF.pdf
http://www.goodmanmfg.com/Portals/0/pdf/SS-GARPF.pdf

<u>Lennox</u>- Two product lines use this test and meet this requirement. Product specifications for Merit® Series CBX26UH/CB26UH-R and Elite® Series CBX27UH/CB27UH air handlers state the following:

> *"Meets Florida standards for less than 2% air leakage from unit."*

http://www.lennox.com/products/list.asp?type=8
http://www.lennox.com/products/overview.asp?model=CBX26UH
http://www.lennox.com/products/overview.asp?model=CBX27UH

Cost Impact: The code change proposal will not increase the cost of construction.

PART II – IRC
Committee Action: **Disapproved**

Committee Reason: The test standard is under development but is not completed. This proposal relies on a Florida Building Code Test Standard that may not be appropriate.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Craig Conner, Building Quality, representing himself, requests Approval as Submitted.

Commenter's Reason: *Jurisdictions legitimately expect the I-codes to be an internally consistent family of model codes that they can use as the foundation for their own building code. This change is one of a series of changes intended to correct a large number of inconsistencies in the residential energy requirements in the IECC and IRC. Greater detail is provided in the reason statements for EC6 and RE6.*

EC70 alignment: EC70 was Approved as Submitted in the IECC and Disapproved in the IRC. To realign the two codes, EC70 should be Approved as Submitted for the IRC.

EC70 content: Sealing air handlers has been a requirement in the IECC and IRC since 2006. As the IECC committee stated, "This proposal provides a useful and practical method for checking for adequate sealing of air handling equipment."
Leaky air handlers waste conditioned air. Unlike ducts, air handlers are constructed in a factory and best sealed by the manufacturer. Without this option, it is not clear how to inspect for a sealed air handler. Most air handler manufacturers are already applying this specific requirement to part or all of their product line.

Final Action: AS AM AMPC____ D

EC71-07/08, Part I
403.2.2, Table 404.5.2(1), Table 404.5.2(2)

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself; Ronald Majette, U.S. Department of Energy

PART I – IECC

Revise as follows:

403.2.2 Sealing. All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3 of the *International Residential Code*. Duct tightness shall be verified by either of the following:

1. Post-construction test: Leakage to outdoors shall be less than or equal to 8 CFM per 100 ft^2 of conditioned floor area or a total leakage less than or equal to 12 CFM per 100 ft^2 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 6 CFM per 100 ft^2 of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the roughed in system, including the manufacturer's air handler enclosure. All register boots 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 4 CFM per 100 ft^2 of conditioned floor area.

Exceptions: Duct tightness test is not required if the air handler and all ducts are located within conditioned space.

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Thermal Distribution Systems	A thermal distribution system efficiency (DSE) of ~~0.80~~ 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be the applicable maximum rate from Section 403.2.2.	~~Same as standard reference design, except~~ As tested or as specified in Table 404.5.2(2) if not tested.

(Portions of table and footnotes not shown remain unchanged)

TABLE 404.5.2(2)
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION:	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	~~0.80~~ --	0.95
Untested d~~D~~istribution systems entirely located in conditioned space [c]	0.88	1.00
~~*Proposed* "reduced leakage" with entire air distribution system located in the conditioned space~~ [~~d~~]	~~0.96~~	~~—~~
~~*Proposed* "reduced leakage" air distribution system with components located in the unconditioned space~~	~~0.88~~	~~—~~
"Ductless" systems [d~~e~~]	1.00	--

a. through c. (No change to current text)

~~d. Proposed "reduced leakage" shall mean leakage to outdoors not greater than 3 cfm per 100 ft2 of conditioned floor area and total leakage not greater than 9 cfm per 100 ft2 of conditioned floor area at a pressure differential of 0.02 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Total leakage of not greater than 3 cfm per 100 ft2 of conditioned floor area at a pressure difference of 0.02 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure, shall be deemed to meet this requirement without measurement of leakage to outdoors. This performance shall be specified as required in the construction documents and confirmed through field-testing of installed systems as documented by an approved independent party.~~

~~e~~ d . Ductless systems may have forced airflow across a coil but shall not have any ducted airflows external to the manufacturer's air handler enclosure.

Reason (Conner): Duct losses account for a substantial portion of the energy used in residences. A practical and relatively low cost means is needed to reduce duct losses. This proposal attempts to get all ducts up to a moderate level of efficiency, it is not attempting to build a "super duct". This proposal has several practical aspects. It lets the duct testing occur at one of two different stages in the building process. This proposal does not specify who has to do the testing. Testing can be avoided by bringing the ducts indoors.

By their nature, duct leaks are unintentional; therefore, the location of the leakage in any particular house is unpredictable and unknown. Duct leakage will usually create imbalances in the air distribution. Duct leaks can potentially create air quality problems by pulling pollutants or irritants directly into the house. As our houses get tighter, reducing duct leakage becomes more important for both housing performance and air quality.

Cost Impact (Conner)**:** The code change proposal will increase the cost of construction.

Reason (Majette): The purpose of this proposal is to reduce energy losses in air-ducted distribution systems.

Is the IECC/IRC requirement for duct sealing working? Despite good intentions, the answer is a convincing "no". Visual inspection of ducts is not adequate. Ducts are often located in difficult to access areas such as attics and crawl spaces. Cracks and other leakage points in ducts may not be visible because they are covered by insulation, hidden from view, or simply too small to be readily apparent to the human eye. Testing of completed homes in Washington state where prescriptive code requirements for duct sealing apply "showed no significant improvement" over non-code homes (Washington State University 2001). Another study from Washington State concluded: "Comparisons to air leakage rates reported elsewhere for homes built before the implementation of the 1991 WSEC show no significant improvement by the general population" despite years of training emphasizing duct sealing (Hales et al. 2003).

Numerous other studies around the nation show substantial duct leakage in new homes, including those in states with codes requiring duct sealing. For example, a 2001 study of 186 houses built under the Model Energy Code in Massachusetts reported "serious problems were found in the quality of duct sealing in about 80% of these houses" (Xenergy 2001). Pressurization tests in 22 of these houses found an average leakage to the outside of the house of 183 cfm, or 21.6% of the system flow, at a pressure of 25 Pascals.

The energy savings of improved duct sealing are very substantial. A California study estimated a sales-weighted state annual average savings from duct sealing of 38 therms and 239 kWh for a 1761 ft^2 house (Hammon and Modera 1999). This is based on an estimated 12% improvement in duct efficiency based on previous studies indicating a 12-15% improvement potential. Assuming $1.20/therm gas and 9 cents/kWh electricity, this is a savings of $67/year. As much of California's population is in mild climates savings should be considerably higher on a national average.

Hammon and Modera (1999) estimate a cost of $214 for materials and labor plus $131 to $163 for testing and suggest costs will be even lower in a mature market. This does not account for possible cost savings from downsizing HVAC systems because of decreased design loads. Even with the conservatively low California energy savings estimate, this is a simple payback of 5.1 to 5.6 years. The Journal of Light Construction (2003) quotes an even lower cost of $220, which indicates a simple payback of under 4 years. Duct pressurization testing equipment commonly known as "duct blasters" cost about $1500-2000 (Sherman, 2004, PDF page 171). Presumably, this equipment would come down in price as the market for this equipment grows.

The proposed leakage limits from duct testing sets a modest target that is reasonable for a mandatory minimum code. For example, Energy Star Qualified Homes must have a leakage of 6 CFM per 100 ft^2 of conditioned floor area (or 4 CFM if the "builder option packages" are used) compared to the 8 cfm per 100 ft^2 proposed here. The proposal allows a variety of compliance methods. Notably, the testing can be done at rough-in stage immediately after the ducts are installed. This allows potentially costly call backs to be avoided if the tested leakage rate exceeds code requirements. Testing is not required if the air handler and ducts are inside the conditioned space.

The residential building energy efficiency requirements in ICC codes have not had a substantial national improvement in 14 years, since 1993. The most notable improvement since 1993 was the addition of the 0.40 SHGC requirement for glazing, and that applies to only the southern third of the nation and occurred 10 years ago. During that time, fuel prices have increased dramatically and environmental concerns from energy usage (notably global warming) have come to the forefront. It's time for the ICC to take serious action to improve energy efficiency in buildings and the Department of Energy believes improved duct systems are the place to start. Poor duct sealing is a widespread problem that will result in senseless energy loss for many decades after a new building is occupied. This proposal represents a reasonable and cost effective improvement that is badly needed.

Bibliography:
Washington State University. 2001. *Washington State Energy Code Duct Leakage Study Report*. WSUCEEP01105. Washington State University Cooperative Extension Energy Program, Olympia, Washington.

Hales, D., A. Gordon, and M. Lubliner. 2003. 2003. *Duct Leakage in New Washington State Residences: Findings and Conclusions.* ASHRAE transactions. KC-2003-1-3.

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Journal of Light Contuction. April 2003. "Pressure-Testing Ductwork." Michael Uniacke.

Sherman et al. 2004. Instrumented HERS and Commissioning.
http://www.energy.ca.gov/pier/final_project_reports/500-04-012.html

Xenergy. 2001. Impact Analysis Of The Massachusetts 1998 Residential Energy Code Revisions.
http://www.mass.gov/Eeops/docs/dps/inf/inf_bbrs_impact_analysis_final.pdf

Cost Impact (Majette): The code change proposal will increase the cost of construction.

PART I – IECC
Committee Action: **Approved as Submitted**

Committee Reason: This code change proposal represents an opportunity for large energy savings using readily available technology.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Shaunna Mozingo, City of Westminster, CO, representing the Colorado Chapter of the International Code Council, requests Disapproval.

Commenter's Reason: Colorado Chapter requests disapproval of Part I. EC71 Part II 07/08 was disapproved by the IRC B/E committee.
The results of the Palm Springs hearings have established Chapter 4 of the IECC and Chapter 11 of the IRC as two separate, distinct sets of minimum standards for the same structure, while the physical dynamics are the same in both.
Divergent actions on this item will lead to confusion and inconsistency in code enforcement and construction. Conflicting requirements devalue the benefits of the IRC as an effective stand alone document. When the differences are justified based on technical merit, we can all readily provide a reasonable explanation and achieve code compliance.
This is one of a series of public comments attempting to bring consistency back to the family of I-codes.

Public Comment 2:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: There are a number of practical implementation problems with this proposal:
- A specific test standard is not referenced on how to perform test.
- There are not enough trained duct tightness testers in the country.
- Education on duct sealing is important. Once a duct installer understands the need and how to properly seal ducts, it will be incorporated into common practice.
- Once the air sealing is being done properly, this $150-$300 test will continue to be needed on all homes without saving any additional energy.
- For example, the Energy Star program, an above code program, only requires duct testing on 1 out of every 7 homes because they understand that once an installer understands how to seal a duct they continue to do it correctly.

This is very subjective and is not spelled out in the proposal. NAHB urges your disproval on this proposal.

Final Action: AS AM AMPC____ D

EC71-07/08, Part II
IRC N1103.2.2

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself; Ronald Majette, U.S. Department of Energy

PART II – IRC

Revise as follows:

N1103.2.2 Sealing. Ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3. <u>Duct tightness shall be verified by either of the following:</u>

1. <u>Post-construction test: Leakage to outdoors shall be less than or equal to 8 CFM per 100 ft^2 of conditioned floor area or a total leakage less than or equal to 12 CFM per 100 ft^2 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.</u>
2. <u>Rough-in test: Total leakage shall be less than or equal to 6 CFM per 100 ft^2 of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the roughed in system, including the manufacturer's air handler enclosure. All register boots 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 4 CFM per 100 ft^2 of conditioned floor area.</u>

<u>**Exceptions:** Duct tightness test is not required if the air handler and all ducts are located within conditioned space.</u>

Reason (Conner): Duct losses account for a substantial portion of the energy used in residences. A practical and relatively low cost means is needed to reduce duct losses. This proposal attempts to get all ducts up to a moderate level of efficiency, it is not attempting to build a "super duct". This proposal has several practical aspects. It lets the duct testing occur at one of two different stages in the building process. This proposal does not specify who has to do the testing. Testing can be avoided by bringing the ducts indoors.

By their nature, duct leaks are unintentional; therefore, the location of the leakage in any particular house is unpredictable and unknown. Duct leakage will usually create imbalances in the air distribution. Duct leaks can potentially create air quality problems by pulling pollutants or irritants directly into the house. As our houses get tighter, reducing duct leakage becomes more important for both housing performance and air quality.

Cost Impact (Conner)**:** The code change proposal will increase the cost of construction.

Reason (Majette): The purpose of this proposal is to reduce energy losses in air-ducted distribution systems.

Is the IECC/IRC requirement for duct sealing working? Despite good intentions, the answer is a convincing "no". Visual inspection of ducts is not adequate. Ducts are often located in difficult to access areas such as attics and crawl spaces. Cracks and other leakage points in ducts may not be visible because they are covered by insulation, hidden from view, or simply too small to be readily apparent to the human eye. Testing of completed homes in Washington state where prescriptive code requirements for duct sealing apply "showed no significant improvement" over non-code homes (Washington State University 2001). Another study from Washington State concluded: "Comparisons to air leakage rates reported elsewhere for homes built before the implementation of the 1991 WSEC show no significant improvement by the general population" despite years of training emphasizing duct sealing (Hales et al. 2003).

Numerous other studies around the nation show substantial duct leakage in new homes, including those in states with codes requiring duct sealing. For example, a 2001 study of 186 houses built under the Model Energy Code in Massachusetts reported "serious problems were found in the quality of duct sealing in about 80% of these houses" (Xenergy 2001). Pressurization tests in 22 of these houses found an average leakage to the outside of the house of 183 cfm, or 21.6% of the system flow, at a pressure of 25 Pascals.

The energy savings of improved duct sealing are very substantial. A California study estimated a sales-weighted state annual average savings from duct sealing of 38 therms and 239 kWh for a 1761 ft^2 house (Hammon and Modera 1999). This is based on an estimated 12% improvement in duct efficiency based on previous studies indicating a 12-15% improvement potential. Assuming $1.20/therm gas and 9 cents/kWh electricity, this is a savings of $67/year. As much of California's population is in mild climates savings should be considerably higher on a national average.

Hammon and Modera (1999) estimate a cost of $214 for materials and labor plus $131 to $163 for testing and suggest costs will be even lower in a mature market. This does not account for possible cost savings from downsizing HVAC systems because of decreased design loads. Even with the conservatively low California energy savings estimate, this is a simple payback of 5.1 to 5.6 years. The Journal of Light Construction (2003) quotes an even lower cost of $220, which indicates a simple payback of under 4 years. Duct pressurization testing equipment commonly known as "duct blasters" cost about $1500-2000 (Sherman, 2004, PDF page 171). Presumably, this equipment would come down in price as the market for this equipment grows.

The proposed leakage limits from duct testing sets a modest target that is reasonable for a mandatory minimum code. For example, Energy Star Qualified Homes must have a leakage of 6 CFM per 100 ft^2 of conditioned floor area (or 4 CFM if the "builder option packages" are used) compared to the 8 cfm per 100 ft^2 proposed here. The proposal allows a variety of compliance methods. Notably, the testing can be done at rough-in stage immediately after the ducts are installed. This allows potentially costly call backs to be avoided if the tested leakage rate exceeds code requirements. Testing is not required if the air handler and ducts are inside the conditioned space.

The residential building energy efficiency requirements in ICC codes have not had a substantial national improvement in 14 years, since 1993. The most notable improvement since 1993 was the addition of the 0.40 SHGC requirement for glazing, and that applies to only the southern third of the nation and occurred 10 years ago. During that time, fuel prices have increased dramatically and environmental concerns from energy usage (notably global warming) have come to the forefront. It's time for the ICC to take serious action to improve energy efficiency in buildings and the Department of Energy believes improved duct systems are the place to start. Poor duct sealing is a widespread problem that will result in senseless energy loss for many decades after a new building is occupied. This proposal represents a reasonable and cost effective improvement that is badly needed.

Bibliography:

Washington State University. 2001. *Washington State Energy Code Duct Leakage Study Report*. WSUCEEP01105. Washington State University Cooperative Extension Energy Program, Olympia, Washington.

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http://www.energy.ca.gov/pier/final_project_reports/500-04-012.html

Xenergy. 2001. Impact Analysis Of The Massachusetts 1998 Residential Energy Code Revisions.
http://www.mass.gov/Eeops/docs/dps/inf/inf_bbrs_impact_analysis_final.pdf

Cost Impact (Majette): The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: **Disapproved**

Committee Reason: It is unclear what is required by the testing procedure. Verification of duct sealing can be achieved with a visual inspection.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Craig Conner, Building Quality, representing himself, requests Approval as Submitted.

Commenter's Reason: *Jurisdictions legitimately expect the I-codes to be an internally consistent family of model codes that they can use as the foundation for their own building code. This change is one of a series of changes intended to correct a large number of inconsistencies in the residential energy requirements in the IECC and IRC. Greater detail is provided in the reason statements for EC6 and RE6.*

EC71 alignment: EC71 was Approved as Submitted in the IECC and Disapproved in IRC. To realign the two codes, EC70 for the IRC should be Approved as Submitted.

EC71 content: EC71 requires ducts be tested or in conditioned space. This is the most energy saving requirement approved this code cycle.

The IRC committee argued that ducts can be inspected visually. If visual inspection of ducts was sufficient, duct leakage would not be one of the largest sources of energy loss in the residence. It seems obvious that ducts are often hidden from view. For any particular duct run the backside of the duct is usually hidden from view. Even when ducts are visible, pressurized air can leak from a multitude of small holes that are difficult to see and evaluate visually.

The simple way to meet this requirement is to move all ducts into conditioned space, which is feasible for most housing designs.

Public Comment 2:

Ronald Majette, U.S. Department of Energy, requests Approval as Submitted.

Commenter's Reason: The purpose of this proposal is to reduce energy losses in air-ducted distribution systems.

This proposal has already been approved by the IECC committee and should be incorporated into the IRC as well for code consistency.

The IRC committee reason states that "verification of ducts can be achieved by visual inspection". The Department of Energy disagrees that visual inspection of ducts is adequate. An open survey conducted by DOE in 2006 found that 85% of 58 respondents (readers of "Setting the Standard": code officials, builders, etc.) believe that the code requirements based only on visual inspection are not adequate (U.S. DOE, 2006). Ducts are often located in difficult to access areas such as attics and crawl spaces. Cracks and other leakage points in ducts may not be visible because they are covered by insulation, hidden from view, or simply too small to be readily apparent to the human eye. Testing of completed homes in Washington state where prescriptive code requirements for duct sealing apply "showed no significant improvement" over non-code homes (Washington State University 2001). Another study from Washington State concluded: "Comparisons to air leakage rates reported elsewhere for homes built before the implementation of the 1991 WSEC show no significant improvement by the general population" despite years of training emphasizing duct sealing (Hales et al. 2003).

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Hammon and Modera (1999) estimate a cost of $214 for materials and labor plus $131 to $163 for testing and suggest costs will be even lower in a mature market. This does not account for possible cost savings from downsizing HVAC systems because of decreased design loads. Even with the conservatively low California energy savings estimate, this is a simple payback of 5.1 to 5.6 years. The Journal of Light Construction (2003) quotes an even lower cost of $220, which indicates a simple payback of under 4 years. Duct pressurization testing equipment commonly known as "duct blasters" cost about $1500-2000 (Sherman, 2004, PDF page 171). Presumably, this equipment would come down in price as the market for this equipment grows.

The proposed leakage limits from duct testing sets a modest target that is reasonable for a mandatory minimum code. For example, Energy Star Qualified Homes must have a leakage of 6 CFM per 100 ft^2 of conditioned floor area (or 4 CFM if the "builder option packages" are used) compared to the 8 cfm per 100 ft^2 proposed here. The proposal allows a variety of compliance methods. Notably, the testing can be done at rough-in stage immediately after the ducts are installed. This allows potentially costly call backs to be avoided if the tested leakage rate exceeds code requirements. Testing is not required if the air handler and ducts are inside the conditioned space.

The residential building energy efficiency requirements in ICC codes have not had a substantial national improvement in 14 years, since 1993. The most notable improvement since 1993 was the addition of the 0.40 SHGC requirement for glazing, and that applies to only the southern third of the nation and occurred 10 years ago. During that time, fuel prices have increased dramatically and environmental concerns from energy usage (notably global warming) have come to the forefront. It's time for the ICC to take serious action to improve energy efficiency in buildings and the Department of Energy believes improved duct systems are the place to start. Poor duct sealing is a widespread problem that will result in senseless energy loss for many decades after a new building is occupied. This proposal represents a reasonable and cost effective improvement that is badly needed.

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Hammon, R. W., and M. P. Modera. 1999. "Improving the Efficiency of Air Distribution Systems in New California Homes-Updated Report." Consol. Stockton, California. http://www.energy.ca.gov/title24/ducttape/documents/IMPROVE_EFFICIENCY_RES.PDF

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Final Action: AS AM AMPC____ D

EC72-07/08, Part I
403.2.2, 403.2.3

Proposed Change as Submitted:

Proponent: Chuck Murray, Washington State University Extension Energy Program, representing Northwest Energy Code Group

PART I – IECC

Revise as follows:

403.2.2 Sealing. All ducts, air handlers, filter boxes, ~~and building cavities used as ducts~~ shall be sealed. Joints and seams shall comply with Section M1601.3 of the *International Residential Code,* or Section 603.9 of the *International Mechanical Code*, as applicable.

403.2.3 Building cavities. Building framing cavities shall not be used as ~~supply~~ ducts.

Reason: This proposal has been submitted to reduce the duct leakage in residential structures. This method is prescriptive and is easy to inspect.

This use of building cavities as duct work has been noted to be a major contributor to duct leakage. Even when a concentrated effort has been made by the contractor to provide an air tight seal, ducts used as building cavities almost always leak. The following quotes from a number of researchers makes the documents the problems with building cavities used as ducts.

Washington State University study of duct leakage in new homes

> *Systems with ducted returns were 47% tighter than systems that used building cavities as part of the return system.*[1]

In the final report form "Improved Air Distribution Systems for Forced Air Heating" a project funded by the Bonneville Power Administration the authors noted,

> *No matter how hard you try to seal a panned joist or wall cavity, you'll never make it tight enough. In fact, one contractor convinced the project's organizers that he could seal a panned joist. He failed even after concerted effort. The three houses with panned joists were all among the top five leakers. One house had 460 cfm of duct leakage.*[2]

In a report by Iain S. Walker, of Lawrence Berkeley National Laboratory the problems of building cavity duct runs were described,

> *Duct leakage is common when parts of the walls or floor cavities used as ducts, e.g., spaces between ceiling or floor joists or internal wall stud spaces. Figure 9 shows basement joists that have been made into a duct using sheet metal "panning". In addition to the leakage at the unsealed sheet metal edges, these panned joists often have holes for plumbing or electrical wires/conduit. Usually it is the air returning to the furnace or air conditioner that flows through these ducts.*[3]

The US Department of Energy Recommends eliminating the use of building cavities as duct work.

> *The entire air distribution system should be "hard" ducted, including returns (i.e., building cavities, closets, raised-floor air handler plenums, platform returns, wall stud spaces, panned floor joists, etc., should not be used)*[4].

[1] David Hales, Washington State Energy Code Duct Leakage Study Report Washington State University Extension Energy Program, 2001. http://www.energy.wsu.edu/pubs/

[2]. Energy Source Builder http://oikos.com/esb/42/airdisproj.html

[3].Iain S. Walker, Sensitivity of Forced Air Distribution System Efficiency to Climate, Duct Location, Air Leakage and Insulation, Lawrence Berkeley National Laboratory, LBNL 43371

[4].AIR DISTRIBUTION SYSTEM DESIGN Good Duct Design Increases Efficiency, Written and prepared for the U.S. Department of Energy by: Southface Energy Institute www.southface.org U.S. Department of Energy's Oak Ridge National Laboratory Buildings Technology Center www.ornl.gov/btc
www.toolbase.org/PDF/DesignGuides/doe_airdistributionsystemdesign.pdf

Cost Impact: The code change proposal will increase the cost of construction.

PART I – IECC
Committee Action: **Disapproved**

Committee Reason: In accordance with the proponent's request.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Ronald Majette, U.S. Department of Energy, requests Approval as Submitted.

Commenter's Reason: This proposal will reduce duct leakage by eliminating the practice of using building cavities as return ducts. Simply put, using building cavities as ducts is a bad idea as these are too difficult to seal properly. The reason statement provided by the proponent of the original proposal (Chuck Murray) provides more support to this claim. Leaks in the return air system will senselessly waste energy for quite possibly the life of the building, up to 50 to 100 years.

The proponent asked for a negative vote on EC72 in the IECC at the code development hearings because EC71 addressed duct leakage and was approved. However, EC71 exempts buildings with ducts located inside the condition spaces from leakage testing requirements. The problem with this is that there still can be pathways through framing cavities to and through the building envelope even when the cavities used as returns are supposedly "inside". It may much more difficult to determine if a building cavity is truly inside the sealed building envelope than to make the same determination for a standalone duct (note the layers in the exterior components where sealing occurs may be different from where insulation is).

Public Comment 2:

Chuck Murray, Washington State University Energy Program, representing Northwest Energy Code Group, requests Approval as Submitted.

Commenter's Reason: The original proposal included modifications to both the energy and mechanical section of three codes. It included commercial as well as residential construction. We have been encouraged by a number of organizations to submit a public comment specific to the energy code compliance in both the IRC and IECC.

With respect to the IECC, with the passage of EC71, we asked for a negative vote EC72. Since then, EC72 has been identified as a critical measure in the reduction of duct leakage, even if EC71 is implemented. The definition of ducts located in the conditioned space is not well defined when building cavities are allowed to be used as air pathways. The reports referenced in the original proposal fully support this. We are submitting this to IRC chapter 11 to provide consistency between the two codes.

Final Action: AS AM AMPC____ D

EC72-07/08, Part II
IRC N1103.2.2, N1103.2.3

Proposed Change as Submitted:

Proponent: Chuck Murray, Washington State University Extension Energy Program, representing Northwest Energy Code Group

PART II – IRC B/E

Revise as follows:

N1103.2.2 Sealing. Ducts, air handlers, filter boxes ~~and building cavities used as ducts~~ shall be sealed. Joints and
seams shall comply with Section M1601.3.

N1103.2.3 Building cavities. Building framing cavities shall not be used as ~~supply~~ ducts <u>or plenums</u>.

Reason: This proposal has been submitted to reduce the duct leakage in residential structures. This method is prescriptive and is easy to inspect.

This use of building cavities as duct work has been noted to be a major contributor to duct leakage. Even when a concentrated effort has been made by the contractor to provide an air tight seal, ducts used as building cavities almost always leak. The following quotes from a number of researchers makes the documents the problems with building cavities used as ducts.

Washington State University study of duct leakage in new homes

> *Systems with ducted returns were 47% tighter than systems that used building cavities as part of the return system.* [1]

In the final report form "Improved Air Distribution Systems for Forced Air Heating" a project funded by the Bonneville Power Administration the authors noted,

> *No matter how hard you try to seal a panned joist or wall cavity, you'll never make it tight enough. In fact, one contractor convinced the project's organizers that he could seal a panned joist. He failed even after concerted effort. The three houses with panned joists were all among the top five leakers. One house had 460 cfm of duct leakage.* [2]

In a report by Iain S. Walker, of Lawrence Berkeley National Laboratory the problems of building cavity duct runs were described,

> *Duct leakage is common when parts of the walls or floor cavities used as ducts, e.g., spaces between ceiling or floor joists or internal wall stud spaces. Figure 9 shows basement joists that have been made into a duct using sheet metal "panning". In addition to the leakage at the unsealed sheet metal edges, these panned joists often have holes for plumbing or electrical wires/conduit. Usually it is the air returning to the furnace or air conditioner that flows through these ducts.* [3]

The US Department of Energy Recommends eliminating the use of building cavities as duct work.

> *The entire air distribution system should be "hard" ducted, including returns (i.e., building cavities, closets, raised-floor air handler plenums, platform returns, wall stud spaces, panned floor joists, etc., should not be used)* [4].

[1] David Hales, <u>Washington State Energy Code Duct Leakage Study Report</u> Washington State University Extension Energy Program, 2001. http://www.energy.wsu.edu/pubs/

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www.toolbase.org/PDF/DesignGuides/doe_airdistributionsystemdesign.pdf

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: **Disapproved**

Committee Reason: This proposal would ban the use of framing cavities as return plenums. Where the ducts are within the conditioned space there should be no problem using frame cavities as ducts. Framing cavities are required to be used on occasion.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Ronald Majette, U.S. Department of Energy, requests Approval as Submitted.

Commenter's Reason: This proposal will reduce duct leakage by eliminating the practice of using building cavities as return ducts. Simply put, using building cavities as ducts is a bad idea as these are too difficult to seal properly. The reason statement provided by the proponent of the original proposal (Chuck Murray) provides more support to this claim. Leaks in the return air system will senselessly waste energy for quite possibly the life of the building, up to 50 to 100 years.

The proponent asked for a negative vote on EC72 in the IECC at the code development hearings because EC71 addressed duct leakage and was approved. However, EC71 exempts buildings with ducts located inside the condition spaces from leakage testing requirements. The problem with this is that there still can be pathways through framing cavities to and through the building envelope even when the cavities used as returns are supposedly "inside". It may much more difficult to determine if a building cavity is truly inside the sealed building envelope than to make the same determination for a standalone duct (note the layers in the exterior components where sealing occurs may be different from where insulation is).

Public Comment 2:

Chuck Murray, Washington State University Energy Program, representing Northwest Energy Code Group, requests Approval as Submitted.

Commenter's Reason: The original proposal included modifications to both the energy and mechanical section of three codes. It included commercial as well as residential construction. We have been encouraged by a number of organizations to submit a public comment specific to the energy code compliance in both the IRC and IECC.

With respect to the IECC, with the passage of EC71, we asked for a negative vote EC72. Since then, EC72 has been identified as a critical measure in the reduction of duct leakage, even if EC71 is implemented. The definition of ducts located in the conditioned space is not well defined when building cavities are allowed to be used as air pathways. The reports referenced in the original proposal fully support this. We are submitting this to IRC chapter 11 to provide consistency between the two codes.

Final Action: AS AM AMPC____ D

NOTE: PART III and IV REPRODUCED FOR INFORMATIONAL PURPOSES ONLY – SEE ABOVE

EC72-07/08, Part III – IRC Mechanical

PART III – IRC–M

Revise as follows:

M1601.1.1 Above-ground duct systems. Above-ground duct systems shall conform to the following:

1. Equipment connected to duct systems shall be designed to limit discharge air temperature to a maximum of 250°F (121°C).
2. Factory-made air ducts shall be constructed of Class 0 or Class 1 materials as designated in Table M1601.1.1(1).
3. Fibrous duct construction shall conform to the SMACNA *Fibrous Glass Duct Construction Standards* or NAIMA *Fibrous Glass Duct Construction Standards*.

4. Minimum thickness of metal duct material shall be as listed in Table M1601.1.1(2). Galvanized steel shall conform to ASTM A 653.
5. Use of gypsum products to construct return air ducts or plenums is permitted, provided that the air temperature.
   does not exceed 125°F (52°C) and exposed surfaces are not subject to condensation.
6. Duct systems shall be constructed of materials having a flame spread index not greater than 200.
7. <u>Stud wall cavities and the spaces between solid floor joists shall not be used as a component of a duct system in new structures.</u> <u>For existing structures,</u> stud wall cavities and the spaces between solid floor joists to be used as air plenums shall comply with the following conditions:
   7.1. These cavities or spaces shall not be used as a plenum for supply air.
   7.2. These cavities or spaces shall not be part of a required fire-resistance-rated assembly.
   7.3. Stud wall cavities shall not convey air from more than one floor level.
   7.4. Stud wall cavities and joist-space plenums shall be isolated from adjacent concealed spaces by tight fitting fire blocking in accordance with Section R602.8.

Reason: (Same as Part I & II)

Cost Impact: The code change proposal will increase the cost of construction.

PART III – IRC-M
Committee Action: **Disapproved**

Committee Reason: There was no technical justification for disallowing a longstanding practice in home construction. This prohibition should have been limited to exterior wall cavities. Any air leakage from interior wall or interstitial floor cavities will be returning to the conditioned space, therefore there is little impact to the energy consumption.

Assembly Action: **None**

EC72-07/08, PART IV – IMC

PART IV – IMC

Revise as follows:

602.3 Stud cavity and joist space plenums. <u>Stud wall cavities and the spaces between solid floor joists shall not be used as a component of a duct system in new structures.</u> <u>For existing structures,</u> stud wall cavities and the spaces between solid floor joists to be utilized as air plenums shall comply with the following conditions:

1. Such cavities or spaces shall not be utilized as a plenum for supply air.
2. Such cavities or spaces shall not be part of a required fire-resistance-rated assembly.
3. Stud wall cavities shall not convey air from more than one floor level.
4. Stud wall cavities and joist space plenums shall comply with the floor penetration protection requirements of the *International Building Code*.
5. Stud wall cavities and joist space plenums shall be isolated from adjacent concealed spaces by approved fireblocking as required in the *International Building Code*.

Reason: (Same as Part I & II)

Cost Impact: The code change proposal will increase the cost of construction.

PART IV – IMC
Committee Action: **Disapproved**

Committee Reason: This code change should have been limited to plenums in exterior wall cavities. The use of interior wall cavities and space between floors is a longstanding practice in building construction.

Assembly Action: **None**

EC74-07/08, Part I
403.3

Proposed Change as Submitted:

Proponent: Michael J. Resetar, Armacell LLC; Roger Schmidt, Nomaco K Flex

PART I – IECC

Revise as follows:

403.3 Mechanical system piping insulation. Mechanical system piping capable of carrying fluids above 105 °F (41 °C) or below 55 °F (13 °C) shall be insulated to a minimum of ~~R-2~~ <u>R-3</u>.

Reason (Part I): In the previous versions of the IECC (2000 IECC & 2003 IECC) there was a table (503.3.3.1) indicating the minimum pipe insulation required (thickness in inches) for low temperature. In an effort to simplify the code in 2006 IECC Section 403.3 reduced the table to a single R Value of 2 and eliminated the table. In the 2 previous published tables the minimum pipe insulation thickness for pipes 1" and less for low temperature called for 1" thick insulation which is R-4. On Runouts up to 2" not exceeding 12 feet the table calls for ½" or R-2. Runouts of less than 12 feet are not common in residential piping and therefore this ½" insulation requirement is rarely invoked. Most residential plumbing falls into the category of low temperature and is less the 1" pipe size which in prior publications would require 1" thick insulation R-4. We do support the effort to simplify codes, but we feel the reduction in insulation thickness has substantially weakened the code itself. We feel that the R-4 Requirement was correct as previously published but feel that a reasonable compromise would be R-3 or ¾" thick as we are proposing.

Cost Impact: The code change proposal will increase the cost of construction.

PART I – IECC
Committee Action: **Approved as Submitted**

Committee Reason: Insulation of hot water piping is an opportunity for large energy savings. This increase in minimum R-value is reasonably affordable.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Shaunna Mozingo, City of Westminster, CO, representing the Colorado Chapter of the International Code Council, requests Disapproval.

Commenter's Reason: The Colorado Chapter requests disapproval of Part I. EC74 Part II 07/08 was disapproved by the IRC B/E committee.

The results of the Palm Springs hearings have established Chapter 4 of the IECC and Chapter 11 of the IRC as two separate, distinct sets of minimum standards for the same structure, while the physical dynamics are the same in both.

Divergent actions on this item will lead to confusion and inconsistency in code enforcement and construction. Conflicting requirements devalue the benefits of the IRC as an effective stand alone document. When the differences are justified based on technical merit, we can all readily provide a reasonable explanation and achieve code compliance.

This is one of a series of public comments attempting to bring consistency back to the family of I-codes.

Public Comment 2:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: There is no energy savings cost justification for adding on "R" to piping insulation. There was No documentation provided to support the large energy savings that the proponent states for this change. This change would eliminate fiberglass from being used as an acceptable material. This proposal also conflicts with EC 133 which has been Approved as Modified at the Public hearing. The additional thickness associated with this level of insulation will be more difficult to install especially for refrigeration lines.

Final Action: AS AM AMPC____ D

EC74-07/08, Part II

IRC N1103.3

Proposed Change as Submitted:

Proponent: Michael J. Resetar, Armacell LLC; Roger Schmidt, Nomaco K Flex

PART II – IRC

Revise as follows:

N1103.3 Mechanical system piping insulation. Mechanical system piping capable of carrying fluids above 105 °F (41 °C) or below 55 °F (13 °C) shall be insulated to minimize ~~R-2~~ R-3

Reason (Part II): In the previous versions of the IRC (2000 IRC & 2003 IRC) there was a table (N1103.5) indicating the minimum pipe insulation required (thickness in inches) for low temperature. In an effort to simplify the code in 2006 IRC Section N1103.3 reduced the table to a single R Value of 2 and eliminated the table. In the 2 previous published tables the minimum pipe insulation thickness for pipes 1" and less for low temperature called for 1" thick insulation which is R-4. Most residential plumbing falls into the category of low temperature and is in prior publications would require 1" thick insulation R-4. We do support the effort to simplify codes, but we feel the reduction in insulation thickness has substantially weakened the code itself. We feel that the R-4 Requirement was correct as previously published but feel that a reasonable compromise would be R-3 or ¾" thick as we are proposing.

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: **Disapproved**

Committee Reason: There was no technical data provided to justify changing the minimum from R-2 to R-3.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Craig Conner, Building Quality, representing himself, requests Approval as Submitted.

Commenter's Reason: *Jurisdictions legitimately expect the I-codes to be an internally consistent family of model codes that they can use as the foundation for their own building code. This change is one of a series of changes intended to correct a large number of inconsistencies in the residential energy requirements in the IECC and IRC. Greater detail is provided in the reason statements for EC6 and RE6.*

EC74 alignment: EC74 was Approved as Submitted in the IECC and Disapproved in IRC. To realign the two codes, EC74 could be Approved as Submitted for the IRC.

EC74 content: EC74 increases the mechanical pipe insulation from R-2 to R-3. Given the frequency with which these pipes carry conditioned fluids, this small change in R-value will likely be cost-effective.

Public Comment 2:

Michael J. Resetar, Armacell LLC and Roger Schmidt, K Flex USA, requests Approval as Submitted.

Commenter's Reason: In the previous versions of the IECC (2000 IECC & 2003 IECC) there was a table (503.3.3.1) indicating the minimum pipe insulation required (thickness in inches) for low temperature. In an effort to simplify the code in 2006 IECC section 403.3 reduced the table to a single R Value of 2 and eliminated the table. In the 2 previous published tables the minimum pipe insulation thickness for pipes 1" and less for low temperature called for 1" thick insulation which is R-4. On Runouts up to 2" not exceeding 12 feet the table calls for ½" or R-2. Runouts of less than 12 feet are not common in residential piping and therefore this ½" insulation requirement is rarely invoked. Most residential plumbing falls into the category of low temperature and is less the 1" pipe size which in prior publications would require 1" thick insulation R-4. We do support the effort to simplify codes, but we feel the reduction in insulation thickness has substantially weakened the code itself. We feel that the R-4 Requirement was correct as previously published but feel that a reasonable compromise would be R-3 or ¾" thick as we are proposing.

Final Action: AS AM AMPC____ D

EC75-07/08
403.4, 403.4.1 (New), 403.4.2 (New), 403.4.3 (New)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

1. Add new text as follows:

403.4 Service water heating. Service water heating systems and piping shall be installed in accordance with the applicable requirements of Sections 403.4.1 through 403.4.2.

403.4.1 Insulation. All Service Hot Water piping shall be insulated to at least R-2 for the distance between the service water heater to within 5 feet of each fixture connected to the hot water pipe.

Exception: Distribution systems that supply hot water from service water heating systems with an efficiency that exceeds prevailing federal minimum standards by at least 15% for gas service water heating equipment and achieve efficiency of at least 1.0 EF for electric service water heating equipment.

403.4.2 Stub-in for solar water. All service water heating distribution systems shall have a stub-in connection point for future Solar Hot Water Systems in an accessible location within 5 feet of the roof.

Exception: Distribution systems that supply hot water from service water heating systems with an efficiency that exceeds prevailing federal minimum standards by at least 15% for gas service water heating equipment and achieve efficiency of at least 1.0 EF for electric service water heating equipment.

(Renumber subsequent sections)

Reason: This proposal requires insulation on all hot water pipes and the installation of a solar hot water stub-in, unless a currently available high efficiency domestic hot water heater is installed, including instantaneous water heaters. As homes have become more efficient, the federal minimum efficiency standard for hot water systems has not kept pace over the years. This proposal will improve the distribution of hot water, improve the likelihood for having renewable solar hot water systems get installed or have the installation of high efficient currently available hot water heating equipment.

Cost Impact: The code change proposal will increase the cost of construction. The initial cost of this improvement may be higher, but the long-term energy savings outweigh these costs.

Committee Action: Disapproved

Committee Reason: This proposal has questionable benefits, given the cost and the difficulty of getting the equipment installed. In addition, such a proposal should be linked to different zones.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Steven Rosenstock, Edison Electric Institute, Harry Misuriello, American Council for Energy Efficient Economy, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

403.4.1 Insulation. All service hot water piping shall be insulated to at least R-2 for pipes sized 1" in diameter or less and R-4 for pipes larger than 1" in diameter for the distance between the service water heater to within 5 feet of each fixture connected to the hot water pipe.

Exception: Hot water d~~D~~istribution systems that meet both of the following criteria: (a) not located below ground or located in a mass floor or mass wall in contact with ground; and (b) that supply hot water from ~~Service Water Heating systems with an efficiency that exceeds prevailing federal minimum standards by at least 15% for~~ either (i) condensing gas service water heating equipment, (ii) instantaneous service electric or gas water heating equipment ~~and achieve efficiency of at least 1.0 EF for~~ or (iii) heat pump electric service water heating equipment.

~~**403.4.2 Stub-in for Solar Water.** All Service Water Heating distribution systems shall have a stub-in connection point for future Solar Hot Water Systems in an accessible location within 5 feet of the roof.~~

~~**Exception:** Distribution systems that supply hot water from Service Water Heating systems with an efficiency that exceeds prevailing federal minimum standards by at least 15% for gas service water heating equipment and achieve efficiency of at least 1.0 EF for electric service water heating equipment.~~

403.4.3 Circulating hot water systems. All circulating service hot water piping shall be insulated to R-2 for pipes sized 1" in diameter or less and R-4 for pipes larger than 1" in diameter. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

Commenter's Reason: Efficiency in the production and distribution of hot water is an important part of meeting the goal of a 30% improvement in energy efficiency for the *IECC*. Unfortunately, due to federal preemption concerns, the energy code cannot mandate more energy efficient equipment than that required by minimum federal standards. However, the code can require a more efficient distribution system (through the requirement of pipe insulation), but permit an exception where the builder installs more efficient hot water heating equipment. Builders would then have more options to meet the requirements. EC75, as written, was intended to implement this approach resulting in important energy efficiency gains.

This proposed modification is intended to achieve the same objectives as the original proposal. At the same time, it is also designed to address some of the concerns raised by proponents and focus on the most important components of the code change. Specifically, the proposed modification removes the requirement for a solar water stub-in to address concerns and claims about the difficulty and questionable benefits of such a requirement. As a result, this modification would make the hot water requirements easier to understand and enforce.

The proposed modification also establishes two different levels of insulation depending on the diameter of the pipe, recognizing that larger diameter pipes carry more water, making more insulation justified. In addition, the modification clarifies the exception by identifying specific hot water heating equipment that would satisfy the exception.

We estimate that EC 75 offers energy savings that range from 1% to 3% in purchased energy savings (heating, cooling and hot water) depending on the energy saved in the hot water system as a percentage of the overall heating, cooling, and hot water energy usage that varies by climate zone.

Support for pipe insulation savings comes from the report by Carl Hiller titled "CEC final Report Phase 1 - Hot Water Distribution Systems" (http://www.cuwcc.org/res_hot_water/CEC-500-2005-161-hot_water_distrib.pdf). Findings from this report include:

- Pipe insulation provides dramatic improvements in pipe cool-down rates, extending cool-down times by 200-400% compared to bare pipe.
- Laboratory testing and analysis showed that the extent to which pipe insulation impacts HWD system energy waste depends on the environment where the pipes are run and the nature of the draws, especially regarding time-spacing of draws.

Final Action: AS AM AMPC____ D

EC77-07/08

403.10

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

Revise as follows:

403.6 Equipment sizing. Heating and cooling equipment shall be sized in accordance with Section M1401.3 of the *International Residential Code*, and this section.

403.6.1 Oversizing limits. The maximum oversizing limit for air conditioners and air-source and ground-source heat pumps is 15% with the following two exceptions: single-speed air-source and ground-source heat pumps in buildings with heating loads that exceed cooling loads have a limit of 25%, and multi-stage heat pumps do not have a strict limit, but shall be sized to allow adequate humidity control in the cooling mode. The maximum oversizing limit for gas, oil or propane heating equipment is 40%.

403.6.2 Operating conditions. The following operating conditions shall be used in the sizing calculations and verified by the code official:

1. Outdoor temperatures shall be the 99.0% and 1.0% design temperatures as published in the ASHRAE Handbook of Fundamentals for the home's location or most representative city for which design temperature data are available;
2. Indoor temperatures shall be 75 F for cooling and 70 F for heating;
3. Infiltration rate shall be selected as "tight", or the equivalent term.

403.6.3 Specifying equipment. ~~In~~ Specification of the next available manufactured size shall be acceptable. In addition, indoor and outdoor coils shall be matched in accordance with ARI Standard 210/240.

Reason: Research and survey data is limited, but typically indicates that HVAC systems are over-sized by as much as 50%, resulting in increased energy consumption and adverse impacts on energy use, comfort and moisture control. This proposal provides an explicit limit on over-sizing and also dictates certain inputs for use in sizing calculations. These inputs will help to ensure that systems are sized in a consistent and reasonable manner.

Current code language, in M1401.3 references ACCA Manual J for load calculation, but does not require that the installed equipment meet a required size. The new language sets a requirement and includes explicit information needed for consistent load calculations and installed equipment size. The actual installed equipment size may be oversized and installed at the next available manufactured size.

The proposed requirements are primarily based on limits that are suggested in ACCA Manual S, which states the following:

- Cooling-only equipment should be sized so that the total cooling capacity does not exceed the total cooling load by more than 15%.
  - If heat pump equipment (air-source or water-source) is installed in a warm or moderate climate, the total cooling capacity should not exceed the total cooling load by more than 15%.
  - If heat pump equipment (air-source or water-source) is installed in a cold climate (where heating costs are a primary concern), the total cooling capacity can exceed the total cooling load by as much as 25%.

● Furnace and boiler oversizing is not recommended because comfort may be compromised when a furnace or boiler short-cycles. The output capacity of the furnace or boiler must be greater than the design load, but no more than 40% larger than the design heating load.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Disapproved

Committee Reason: This proposal is not needed given committee action on EC64-07/08. The proposal also references the IRC as the reference technical base for the requirement, which is inappropriate for the IECC.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Steven Rosenstock, Edison Electric Institute, Harry Misuriello, American Council for Energy Efficient Economy, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

403.6 Equipment sizing. Heating and cooling equipment shall be sized in accordance with ~~Section M1401.3 of the International Residential Code, and~~ this section and Table 403.6.

~~**403.6.1 Oversizing Limits.** The maximum oversizing limit for air conditioners and air-source and ground-source heat pumps is 15% with the following two exceptions: single-speed air-source and ground-source heat pumps in buildings with heating loads that exceed cooling loads have a limit of 25%, and multi-stage heat pumps do not have a strict limit, but shall be sized to allow adequate humidity control in the cooling mode. The maximum oversizing limit for gas, oil or propane heating equipment is 40%.~~

TABLE 403.6

UNIT	MAXIMUM PERCENTAGE OVESIZING [1,2]	CLIMATE ZONE	MINIMUM EFFICIENCY & TEST PROCEDURES
Air Conditioners	15%	ALL	Table 503.2.3(1)
Multi-speed[3] Air-Source Heat Pumps and Ground-Source Heat Pumps	15%	ALL	Table 503.2.3(2)
Single -speed Air-Source Heat Pumps and Ground Source Heat Pumps	15% 25%	1-3 ---- 4-8	Table 503.2.3(2) or Table 503.2.3(3)
All fuel-fired heating appliances	40%	ALL	Table 503.2.3(4) or Table 503.2.3(5)

Notes: ~~**403.6.2 Operating conditions.** The following operating conditions shall be used in the sizing calculations and verified by the code official:~~

1. Equipment shall be sized in accordance with ACCA Manual J:
   a. Indoor and outdoor coils shall be matched for size;
   b. Outdoor temperatures shall be the 99.0% and 1.0% design temperatures as published in the ASHRAE Handbook of Fundamentals for the ~~home's location or~~ most representative city for which design temperature data are available;
   c. ~~2.~~ Indoor temperatures shall be 75 F for cooling and ~~70~~ 72 F for heating;
   d. ~~3.~~ Infiltration rate shall be ~~selected as "tight", or the equivalent term~~ assumed as 0.00036 Specific Leakage Area (SLA).
2. ~~**403.6.3 Specifying equipment.** Specification of~~ Once the appropriate equipment size is determined, if that specific size does not exist, the next larger size of ~~available~~ manufactured ~~size~~ equipment shall be acceptable, regardless of the percentage listed. ~~In addition, indoor and outdoor coils shall be matched in accordance with ARI Standard 210/240.~~
3. Multi-speed units shall be permitted to exceed the listed percentage only to the cooling capacity necessary to control humidity levels.

Add the following reference to Chapter 6:

ACCA Manual J 2006

Commenter's Reason: By establishing specific requirements in the *IECC* for proper equipment sizing, this proposal is an important part of EECC's package seeking a 30% improvement in energy efficiency in the code. Equipment that is excessively oversized utilizes more energy and fails to properly condition the space. The EECC believes that EC77, as originally proposed, is a valuable addition to the *IECC*. However, EECC is offering this modification in order to respond to the Development Committee's reasons for recommending disapproval.

First, in addressing equipment sizing, the existing *IECC* merely references section M1401.3 of the *IRC*. Section M1401.3 then directs the user to ACCA Manual J. The Code Development Committee criticized the original proposal for maintaining the reference to the *IRC*, even though the original proposal simply included the current code language, unchanged. In response to this concern, this modification removes the reference. Instead, the modification specifically directs the user to Manual J and adds Manual J as a referenced standard to the IECC. Since Manual J is already a referenced standard in the IRC and has been reviewed for acceptability by staff, we propose that adding the reference to a second I-code is not an issue.

Second, the Code Development Committee concluded that EC77 was not needed given Committee action on EC64. However, we believe that EC64 does not directly address sizing and therefore specific sizing requirements would be a useful addition to the IECC.

Finally, this public comment modifies EC-77 to make it more consistent code language and easier to use. For example, the revisions include setting forth requirements in an easy-to-use table and specifying consistent values for indoor design temperatures and air leakage.

Final Action: AS AM AMPC____ D

EC78-07/08, Part I
403.7 (New), Table 403.7 (New), Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself

PART I – IECC

1. Add new text and table as follows:

403.7 Furnace efficiency. Where not prohibited by Federal law, furnace efficiency shall be as prescribed in Table 403.7

(Renumber subsequent sections)

TABLE 403.7
MINIMUM FURNACE EFFICIENCY

FURNACE	AFUE
New residences non-weatherized gas furnaces in zones 5, 6, 7, 8, and 4 Marine	90
All other non-weatherized gas furnaces	80
Weatherized gas furnaces	83
Oil-fired furnaces	82
Gas boilers	84
Oil-fired boilers	83

2. Revise table as follows:

TABLE 404.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS (Supp)

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems[h, i]	Fuel type: same as proposed design Efficiencies: Electric: air-source heat pump with prevailing ~~federal~~ minimum efficiency Nonelectric furnaces: natural gas furnace with prevailing ~~federal~~ minimum efficiency Nonelectric boilers: natural gas boiler with prevailing ~~federal~~ minimum efficiency Capacity: sized in accordance with Section M1401.3 of the *International Residential Code*	(No change)
Cooling systems[h, j]	Fuel type: Electric Efficiency: in accordance with prevailing ~~federal~~ minimum ~~standards~~ efficiency Capacity: sized in accordance with Section M1401.3 of the *International Residential Code*	(No change)
Service water heating[h, k]	Fuel type: same as proposed design Efficiency: in accordance with prevailing ~~federal~~ minimum ~~standards~~ efficiency Use: gal/day = 30 + 10 x N_{br} Tank temperature: 120°F	(No change)

(Portions of table and footnotes not shown remain unchanged)

Reason: Although Federal law (NAECA) preemptively regulates residential heating equipment efficiency, the law allows states and regions to petition DOE for a waiver to set higher local requirements. In the event that a state sets a higher requirement, the IECC/IRC in its current form will be left with an inconsistency. Prescriptively complied homes will have higher heating efficiency than the code will use as a baseline in the performance path, resulting in a loophole.

The northern US furnace market is moving towards high-efficiency furnaces at or above 90 AFUE. DOE's Federal Register Notice says that almost 50% of the new homes in parts of the northern US have condensing efficiencies. Some states and regions are in the process of petitioning DOE to require higher AFUEs more will likely follow.

As part of its analysis, DOE determined cost-effective AFUEs for various types of furnaces. Those levels are the basis for this code change. As shown in the proposed table, the cost-effective level DOE found varied somewhat with furnace type. Unfortunately, DOE will not mandate these more efficient, cost-effective levels until 2015, presuming no further delays. Given the large amount of energy devoted to heating, it seems prudent to establish higher furnace efficiency levels prior to 2015. Furthermore, several states/regions are likely to petition DOE for these higher AFUEs prior to 2015.

In one important case DOE determined it did not have the authority to implement a more cost-effective furnace--a 90 AFUE gas furnace inside new homes in northern climates. DOE examined the northern states with heating degree days (HDD) >5000 separately (roughly climate zones 5 through 8 and Marine 4), which are almost the same areas as those proposed here for 90 AFUE. In the DOE analysis, the indoor 90 AFUE furnace in the northern states generated a substantial net present value (Federal Register Notice, page 29253, Table VI.1) with substantial energy savings (1.72 Quads over 24 years). DOE commented that a 90 AFUE requirement in the northern states and a lower AFUE in the southern states had a significantly higher net present value than the single uniform requirement DOE was required to propose.

DOE examined the 90 AFUE gas furnaces separately for new and existing homes, breaking the cost into equipment cost and installation cost. The equipment cost for a 90 AFUE gas furnace is more than the cost for a 78 AFUE gas furnace. However, the situation is reversed for venting costs. Condensing furnaces (90 AFUE) and non-condensing furnaces (78 or 80 AFUE) use significantly different venting. Condensing furnaces typically use a short horizontal plastic pipe, while non-condensing furnaces need a chimney. An inside 90 AFUE condensing gas furnace replacing an existing 80 AFUE non-condensing furnace probably incurs additional costs to modify the venting. However, in new construction condensing furnaces are actually cheaper to vent. DOE estimated that in new homes the condensing furnace venting actually saved $138 (TSD, page 6-34, Table 6.5.7). Because DOE was constrained to lump new home furnaces (25%) and existing home furnaces (75%) together, it could not take advantage of the cost-effectiveness of the 90 AFUE furnace in new construction. However, states, regions, and the I-codes are not constrained to lump new and existing requirements together if they have a waiver from DOE.

Based on the DOE analysis, high-efficiency furnaces are very cost-effective for new homes in northern heating-dominated climates. This proposal sets the cost-effective 90 AFUE as the minimum inside gas furnace efficiency for new homes in the northern US.

In its Federal Register Notice, DOE almost encourages states/regions to petition for a waiver, and suggests northern climates have a strong argument for an inside 90 AFUE gas furnace due to the higher heating loads. DOE suggests that it would look favorably on the higher AFUE (90 AFUE) already in common use in northern climates and on uniform requirements covering large contiguous geographical areas. If this code change prevails, states/regions would also be able to argue that they are petitioning to be allowed to be consistent with the IECC/IRC. Several states, or groups of states, are preparing or planning petitions for higher AFUE furnaces.

This change promotes higher equipment efficiency where it is cost-effective, and eliminates a loophole in the performance calculation.

Note:
U.S. Department of Energy Federal Register Notice dated October 6, 2006. *Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces and Boilers; Proposed Rule*, or from its technical support document available at: http://www.eere.energy.gov/buildings/appliance_standards/residential/furnaces_boilers_1113_r.html

Cost Impact: The code change proposal will increase the cost of construction.

PART I – IECC
Committee Action: Disapproved

Committee Reason: The proposed requirements would be too complicated to enforce. In addition, this could have the effect of preempting federal requirements.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Craig Conner, Building Quality, representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

403.7 Furnace efficiency. Where not prohibited by Federal law<u>, 90 AFUE shall be the minimum indoor gas </u>furnace efficiency<u> required for new residencies in zones 5 to 8 and Marine 4.</u> ~~shall be as in Table 403.7~~

~~Table 403.7~~
~~Minimum Furnace Efficiency~~

~~Furnace~~	~~AFUE~~
~~New residences non-weatherized gas furnaces in zones 5, 6, 7, 8, and 4 Marine~~	~~90~~
~~All other non-weatherized gas furnaces~~	~~80~~
~~Weatherized gas furnaces~~	~~83~~
~~Oil-fired furnaces .~~	~~82~~
~~Gas boilers~~	~~84~~
~~Oil-fired boilers~~	~~83~~

(Portions of proposal not shown remain unchanged)

Commenter's Reason: High-efficiency gas furnaces, furnaces with an AFUE of 90 or more, are very cost-effective in northern climates in new residences.

High and low efficiency furnaces differ in their use of a chimney/drain. Non-condensing gas furnaces with an AFUE of 78 or 80 use a conventional chimney. Condensing furnaces with an AFUE of 90 or more use a less-expensive condensate drain--usually a short horizontal plastic pipe. Unfortunately that condensate drain, which is a savings in new homes, is an added cost when replacing an existing non-condensing furnace with a condensing furnace. Therefore, replacing an existing gas furnace with a 90 AFUE gas furnace is much less cost-effective than the same furnace in a new home.

DOE recently set a rather anemic Federal standard for gas furnace efficiency-- 80 AFUE by the year 2015. In explaining its actions in the Federal Register, DOE stated that it found high-efficiency gas furnaces to be cost-effective for new homes in the north but lacked the authority to set separate standards for regions or new homes Recent changes in Federal law give DOE the authority to propose regional furnace requirements. However, DOE still lacks the authority to propose separate requirements for new and existing residences. The IECC/IRC and implementing jurisdictions can recognize the cost-effectiveness of a northern minimum 90 AFUE gas furnace requirement for new residences.

Existing Federal law (NAECA) allows states and regions to petition DOE for a waiver to set higher local equipment efficiency requirements. DOE's analysis shows higher levels of gas furnace efficiency are a very cost-effective way to achieve energy efficiency for new homes in the north. EC79 encourages the use of condensing gas furnaces with an AFUE of 90 or more in new homes in the north. EC79 also modifies the performance calculations such that any new state or regional requirement, even if above the Federal minimum, becomes the basis for the performance calculation in the code.

Both committees disapproved this change; their reasons with responses are as follows:

"*The new requirements are too complicated to enforce.*"- Agreed. This modification eliminates the table and focuses on the case where substantial efficiency is available--indoor gas furnaces in new homes in the north.
"*This could have the effect of preempting Federal requirements.*" "*This would add a requirement that can only apply once a Federal law authorizes it.*" Federal law specifically allows states and regions to apply for permission to set higher levels. DOE already has the authority to grant this permission. DOE's written rational for its latest furnace efficiency action almost requests states and regions to petition for permission to require higher efficiency using the existing Federal process.

"*There are undefined terms non-authorized and authorized*." Presumably this is a misprint and the committee was actually referring to the terms "*weatherized*" and "*non-weatherized,*" which are DOE's terms for outdoor and indoor furnaces, respectively. A common term "indoor" already used in the code was substituted for "non-weatherized."
"*The proposal would make it cost prohibitive to retrofit flue replacement and condensate drain placement*."- Agreed. The committee correctly recognizes that replacing existing gas furnaces with the new condensing gas furnaces would require an expensive retrofit flue replacement and condensate drain placement. The committee explained why this proposed requirement applies only to new residences.

The IECC and IRC should recognize the cost-effective efficiency resulting from a 90 AFUE gas furnace requirement for new homes in the north.

Final Action: AS AM AMPC____ D

EC78-07/08, Part II
IRC N1103.7 (New), Table N1103.7 (New)

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself

PART II – IRC B/E

Add new text and table as follows:

N1103.7 Furnace efficiency. Where not prohibited by Federal law, furnace efficiency shall be as in prescribed Table N1103.7

TABLE N1103.7
MINIMUM FURNACE EFFICIENCY

FURNACE	AFUE
New residences non-weatherized gas furnaces in zones 5, 6, 7, 8, and 4 Marine	90
All other non-weatherized gas furnaces	80
Weatherized gas furnaces	83
Oil-fired furnaces	82
Gas boilers	84
Oil-fired boilers	83

Reason: Although Federal law (NAECA) preemptively regulates residential heating equipment efficiency, the law allows states and regions to petition DOE for a waiver to set higher local requirements. In the event that a state sets a higher requirement, the IECC/IRC in its current form will be left with an inconsistency. Prescriptively complied homes will have higher heating efficiency than the code will use as a baseline in the performance path, resulting in a loophole.

The northern US furnace market is moving towards high-efficiency furnaces at or above 90 AFUE. DOE's Federal Register Notice says that almost 50% of the new homes in parts of the northern US have condensing efficiencies. Some states and regions are in the process of petitioning DOE to require higher AFUEs more will likely follow.

As part of its analysis, DOE determined cost-effective AFUEs for various types of furnaces. Those levels are the basis for this code change. As shown in the proposed table, the cost-effective level DOE found varied somewhat with furnace type. Unfortunately, DOE will not mandate these more efficient, cost-effective levels until 2015, presuming no further delays. Given the large amount of energy devoted to heating, it seems prudent to establish higher furnace efficiency levels prior to 2015. Furthermore, several states/regions are likely to petition DOE for these higher AFUEs prior to 2015.

In one important case DOE determined it did not have the authority to implement a more cost-effective furnace--a 90 AFUE gas furnace inside new homes in northern climates. DOE examined the northern states with heating degree days (HDD) >5000 separately (roughly climate zones 5 through 8 and Marine 4), which are almost the same areas as those proposed here for 90 AFUE. In the DOE analysis, the indoor 90 AFUE furnace in the northern states generated a substantial net present value (Federal Register Notice, page 29253, Table VI.1) with substantial energy savings (1.72 Quads over 24 years). DOE commented that a 90 AFUE requirement in the northern states and a lower AFUE in the southern states had a significantly higher net present value than the single uniform requirement DOE was required to propose.

DOE examined the 90 AFUE gas furnaces separately for new and existing homes, breaking the cost into equipment cost and installation cost. The equipment cost for a 90 AFUE gas furnace is more than the cost for a 78 AFUE gas furnace. However, the situation is reversed for venting costs. Condensing furnaces (90 AFUE) and non-condensing furnaces (78 or 80 AFUE) use significantly different venting. Condensing furnaces typically use a short horizontal plastic pipe, while non-condensing furnaces need a chimney. An inside 90 AFUE condensing gas furnace replacing an existing 80 AFUE non-condensing furnace probably incurs additional costs to modify the venting. However, in new construction condensing furnaces are actually cheaper to vent. DOE estimated that in new homes the condensing furnace venting actually saved $138 (TSD, page 6-34, Table 6.5.7). Because DOE was constrained to lump new home furnaces (25%) and existing home furnaces (75%) together, it could not take advantage of the cost-effectiveness of the 90 AFUE furnace in new construction. However, states, regions, and the I-codes are not constrained to lump new and existing requirements together if they have a waiver from DOE.

Based on the DOE analysis, high-efficiency furnaces are very cost-effective for new homes in northern heating-dominated climates. This proposal sets the cost-effective 90 AFUE as the minimum inside gas furnace efficiency for new homes in the northern US.

In its Federal Register Notice, DOE almost encourages states/regions to petition for a waiver, and suggests northern climates have a strong argument for an inside 90 AFUE gas furnace due to the higher heating loads. DOE suggests that it would look favorably on the higher AFUE (90 AFUE) already in common use in northern climates and on uniform requirements covering large contiguous geographical areas. If this code change prevails, states/regions would also be able to argue that they are petitioning to be allowed to be consistent with the IECC/IRC. Several states, or groups of states, are preparing or planning petitions for higher AFUE furnaces.

This change promotes higher equipment efficiency where it is cost-effective, and eliminates a loophole in the performance calculation.

Note:
U.S. Department of Energy Federal Register Notice dated October 6, 2006. *Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces and Boilers; Proposed Rule*, or from its technical support document available at:
http://www.eere.energy.gov/buildings/appliance_standards/residential/furnaces_boilers_1113_r.html

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: Disapproved

Committee Reason: This proposal would make it cost prohibitive to retrofit flue placement and condensate drain placement. There are undefined terms non-authorized and authorized. Also, this would add a requirement that can only apply once a Federal Law authorizes it.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Craig Conner, Building Quality, representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

N1103.7 Furnace efficiency. Where not prohibited by Federal law, 90 AFUE shall be the minimum indoor gas furnace efficiency required for new residencies in zones 5 to 8, and Marine 4. ~~shall be as in Table N1103.7~~

~~TABLE N1103.7~~
~~MINIMUM FURNACE EFFICIENCY~~

~~Furnace~~	~~AFUE~~
~~New residences non-weatherized gas furnaces in zones 5, 6, 7, 8, and 4 Marine~~	~~90~~
~~All other non-weatherized gas furnaces~~	~~80~~
~~Weatherized gas furnaces~~	~~83~~
~~Oil-fired furnaces .~~	~~82~~
~~Gas boilers~~	~~84~~
~~Oil-fired boilers~~	~~83~~

Commenter's Reason: High-efficiency gas furnaces, furnaces with an AFUE of 90 or more, are very cost-effective in northern climates in new residences.

High and low efficiency furnaces differ in their use of a chimney/drain. Non-condensing gas furnaces with an AFUE of 78 or 80 use a conventional chimney. Condensing furnaces with an AFUE of 90 or more use a less-expensive condensate drain--usually a short horizontal plastic pipe. Unfortunately that condensate drain, which is a savings in new homes, is an added cost when replacing an existing non-condensing furnace with a condensing furnace. Therefore, replacing an existing gas furnace with a 90 AFUE gas furnace is much less cost-effective than the same furnace in a new home.

DOE recently set a rather anemic Federal standard for gas furnace efficiency-- 80 AFUE by the year 2015. In explaining its actions in the Federal Register, DOE stated that it found high-efficiency gas furnaces to be cost-effective for new homes in the north but lacked the authority to set separate standards for regions or new homes Recent changes in Federal law give DOE the authority to propose regional furnace requirements. However, DOE still lacks the authority to propose separate requirements for new and existing residences. The IECC/IRC and implementing jurisdictions can recognize the cost-effectiveness of a northern minimum 90 AFUE gas furnace requirement for new residences.

Existing Federal law (NAECA) allows states and regions to petition DOE for a waiver to set higher local equipment efficiency requirements. DOE's analysis shows higher levels of gas furnace efficiency are a very cost-effective way to achieve energy efficiency for new homes in the north. EC79 encourages the use of condensing gas furnaces with an AFUE of 90 or more in new homes in the north. EC79 also modifies the performance calculations such that any new state or regional requirement, even if above the Federal minimum, becomes the basis for the performance calculation in the code.

Both committees disapproved this change; their reasons with responses are as follows:

"*The new requirements are too complicated to enforce.*"- Agreed. This modification eliminates the table and focuses on the case where substantial efficiency is available--indoor gas furnaces in new homes in the north.
"*This could have the effect of preempting Federal requirements.*" "*This would add a requirement that can only apply once a Federal law authorizes it.*" Federal law specifically allows states and regions to apply for permission to set higher levels. DOE already has the authority to grant this permission. DOE's written rational for its latest furnace efficiency action almost requests states and regions to petition for permission to require higher efficiency using the existing Federal process.

"*There are undefined terms non-authorized and authorized*." Presumably this is a misprint and the committee was actually referring to the terms "*weatherized*" and "*non-weatherized,*" which are DOE's terms for outdoor and indoor furnaces, respectively. A common term "indoor" already used in the code was substituted for "non-weatherized."
"*The proposal would make it cost prohibitive to retrofit flue replacement and condensate drain placement*."- Agreed. The committee correctly recognizes that replacing existing gas furnaces with the new condensing gas furnaces would require an expensive retrofit flue replacement and condensate drain placement. The committee explained why this proposed requirement applies only to new residences.

The IECC and IRC should recognize the cost-effective efficiency resulting from a 90 AFUE gas furnace requirement for new homes in the north.

Final Action: AS AM AMPC____ D

EC79-07/08, Part I

403.7 (New)

Proposed Change as Submitted:

Proponent: Shirley Muns, US Green Fiber, LLC

PART I – IECC

Add new text as follows:

403.7 Gas water heaters. All gas water heaters shall be equipped with a pilotless electronic ignition system.

(Renumber subsequent sections)

Reason: The water heater accounts for about 1/3 of all home energy use. The pilot lights in gas water heaters waste a lot of energy and increase emissions. Pilotless ignitions in gas ranges save about 30 percent of gas usage over the constantly burning pilot light, the same savings could be attributed to pilotless water heaters. Installing a water heater with an electronic ignition system in lieu of one with a standing gas pilot light would require the addition of one receptacle, which should be a minimum cost increase in new construction. Additional costs would be the difference in costs between the pilotless and the standing pilot water heaters. Eliminating standing pilots will reduce the energy usage considerably and should have a payback of less than 2 years.

Cost Impact: The code change proposal will increase the cost of construction.

PART I – IECC
Committee Action: **Approved as Submitted**

Committee Reason: Pilotless ignition systems represent a significant opportunity for saving energy.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Patrick A. McLaughlin, McLaughlin & Associates, representing The Air-Conditioning, Heating and Refrigeration Institute, requests Disapproval.

Commenter's Reason: This code change should be disapproved because it is preempted by federal law. The U.S. Department of Energy has the responsibility and authority to establish national efficiency requirements for residential and commercial gas water heaters. Congress stated when enacting the National Appliance Energy Conservation Act (NAECA); "The purpose of S.83 is to reduce the Nation's consumption of energy and to reduce the regulatory and economic burdens on the appliance manufacturing industry through the establishment of national energy conservation standard for major residential appliances." Water heaters are listed as a covered product in Section 6292(a) (4) of Title 42, Chapter 77, Subchapter III, Part A, Energy Conservation Program for Consumer Products Other Than Automobiles.

The rulemaking that resulted in the current minimum efficiency requirements for residential water heaters was conducted by DOE in the late 1990s. At that time, DOE determined that replacing the standing pilot with an electronic ignition system did not save significant energy and was not cost effective. DOE is now conducting another rulemaking to update the minimum efficiency requirements for residential water heaters. The benefit of using electronic ignition systems on gas water heaters will be considered again. The proponent should submit this proposal to DOE.

However, DOE may again determine that this is not a cost effective energy measure. A typical pilot consumes 400 to 500 Btu/h. The recovery efficiency of a gas water heater is around 75%. The pilot is as efficient as the main burner; therefore only 25% of the pilot consumption is lost energy. Under typical usage a residential gas water heater is in stand by for about 22 hours a day. The annual gas savings is between 8 and 10 therms a year (450x.25x22x365/100,000 = 903,375 Btu = 9 therms). At current (2007) DOE national average gas costs ($1.218 per therm) this is a savings of around $11. The electronic ignition system that would replace the standing pilot consumes electricity. In its previous rulemaking DOE estimated the annual electric consumption of the electronic ignition system to be about 26 kW. At the 2007 DOE national average electric cost (10.65 cents per kWh) this adds about $3 to the operating cost of the water heater. The net savings would be around $8. The pay back is not two years, as the proponent claims.

If the preemption is ignored, note that there are no implementation dates in the proposal, thus the requirements would be effective on the day that each local jurisdiction adopts the code. For obvious reasons, any proposal of this nature requires phased implementation.

The code change should be disapproved because the regulation is preempted by NAECA, DOE is currently addressing the subject, and the savings are minimal.

This proposal was disapproved by the IRC RE Committee.

Public Comment 2:

Shaunna Mozingo, City of Westminster, CO, representing the Colorado Chapter of the International Code Council, requests Disapproval.

Commenter's Reason: The Colorado Chapter requests disapproval of Part I. EC79 Part II 07/08 was disapproved by the IRC B/E committee.

The results of the Palm Springs hearings have established Chapter 4 of the IECC and Chapter 11 of the IRC as two separate, distinct sets of minimum standards for the same structure, while the physical dynamics are the same in both.

Divergent actions on this item will lead to confusion and inconsistency in code enforcement and construction. Conflicting requirements devalue the benefits of the IRC as an effective stand alone document. When the differences are justified based on technical merit, we can all readily provide a reasonable explanation and achieve code compliance.

This is one of a series of public comments attempting to bring consistency back to the family of I-codes.

Public Comment 3:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The 2-year payback and savings that the proponent reported are highly exaggerated. The pilot light is generally located below the water tank and is nearly as efficient as the gas burner in full operation essentially eliminating any energy savings. This proposed change will now require electricity to power an exhaust blower whereas the natural draft does not; the electricity usage was not taken into consideration in the cost justification. Also, during prolonged outages, a piloted water heater will continue to work where an electronic ignition gas water heater will not.

This is not an issue that the building codes should be addressing- this is an appliance issue.

Public Comment 4:

Ted A. Williams, American Gas Association, requests Disapproval.

Commenter's Reason: The reason for disapproval by the IRC Committee regarding federal preemption is correct. Federal law preempts setting of standards on the products covered by the proposal. ICC should not promulgate requirements that are in conflict with federal preemption requirements. To do so would make state adoption of the IECC impossible without a parallel approval of federal exemption from preemption. The U. S. Department of Energy (DOE) has an active agenda for rulemaking covering the subject matter of the proposal in which the proponent's proposed technical change can be addressed. The proponent should be encouraged to put the proposal forward there and not within the IECC. The IECC Committee needs to reconsider its understanding of the federal preemption language as stated at the Palm Springs hearings and seek guidance from ICC generally on how these requirements relate to IECC proposals. The ICC membership needs to assess the IECC Committee vote in context of this issue and disapprove the proposal. The membership also needs to be aware that the potential for "significant" energy savings from the proposal is erroneous. Technical information on energy consumption from standing pilots developed in laboratory testing and analysis by Battelle Memorial Institute, Columbus, Ohio, demonstrates that this energy is not wasted as the proponent maintained in testimony. This issue, nevertheless, needs to be addressed in a proper rulemaking proceeding as is scheduled by DOE, which is scheduled to issue an Advanced Notice of Proposed Rulemaking (ANOPR) on these products this year.

Final Action: AS AM AMPC____ D

EC79-07/08, Part II
IRC N1104.2 (New)

Proposed Change as Submitted:

Proponent: Shirley Muns, US Green Fiber, LLC

PART II – IRC

Add new text as follows:

<u>**N1104.2 Gas water heaters.** All gas water heaters shall be equipped with a pilotless electronic ignition system.</u>

Reason: The water heater accounts for about 1/3 of all home energy use. The pilot lights in gas water heaters waste a lot of energy and increase emissions. Pilotless ignitions in gas ranges save about 30 percent of gas usage over the constantly burning pilot light, the same savings could be attributed to pilotless water heaters. Installing a water heater with an electronic ignition system in lieu of one with a standing gas pilot light would require the addition of one receptacle, which should be a minimum cost increase in new construction. Additional costs would be the difference in costs between the pilotless and the standing pilot water heaters. Eliminating standing pilots will reduce the energy usage considerably and should have a payback of less than 2 years.

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: **Disapproved**

Committee Reason: No evidence has been presented to show that this is a significant energy benefit. The pilot light will operate when there is a power outage. This may preempt Federal Law.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Craig Conner, Building Quality, representing himself, requests Approval as Submitted.

Commenter's Reason: *Jurisdictions legitimately expect the I-codes to be an internally consistent family of model codes that they can use as the foundation for their own building code. This change is one of a series of changes intended to correct a large number of inconsistencies in the residential energy requirements in the IECC and IRC. Greater detail is provided in the reason statements for EC6 and RE6.*

EC79 alignment: EC79 was Approved as Submitted in the IECC and Disapproved in IRC. <u>To realign the two codes, EC79 should be Approved as Submitted for the IRC</u>.

EC79 content: EC79 requires electronic ignition for gas water heaters. The IECC committee explained *"Pilotless ignition systems represent a significant opportunity for saving energy"* as the reason for approving this change.

The IRC committee stated that *"No evidence has been presented to show that this is a significant energy benefit."* In its residential water heater rulemaking[1] the US Department of Energy's Technical Support Document estimates that water heater pilot lights consume about 450 Btu/hr, but that electronic pilot lights consume less than 1/10 of that during heating periods and less than 1/100 of that during standby periods[2]. Even allowing for some of the pilot light heat becoming useful heat, electronic pilot lights save significant energy; therefore, the electronic pilot light would be a useful energy-efficient feature for a water heater.

1 See http://www.eere.energy.gov/buildings/appliance_standards/residential/waterheaters.html
2 Page 8-39. http://www.eere.energy.gov/buildings/appliance_standards/residential/pdfs/08.pdf

Final Action: AS AM AMPC____ D

EC81-07/08, Part II
IRC N1103.7 (New), N1103.7.1 (New), N1103.7.2 (New), N1103.7.3 (New)

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS ON THE CONSENT AGENDA. PART I IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY FOLLOWING ALL OF PART II.

Proposed Change as Submitted:

Proponent: Chuck Murray, Washington State University Extension Energy Program, representing Northwest Energy Code Group

PART II – IRC

Add new text as follows:

N1103.7 Pools. Pools shall be provided with energy conserving measures in accordance with Sections N1103.1 through N1103.7.3.

N1103.7.1 Pool heaters. All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.

N1103.7.2 Time switches. Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Where pumps are required to operate solar-and waste-heat-recovery pool heating systems.

N1103.7.3 Pool covers. Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12.

Exception: Pools deriving over 60 percent of the energy for heating from site-recovered energy or solar energy source.

Reason: The text for energy conservation for swimming pools has been taken from the commercial chapter of this code. This text was also included in the 2003 IECC, Chapter 5 for residential projects. Similar language also appears in ANSI/ASHRAE 90.1-2004. This language should also be included in the residential sections of this code.

A pool cover will reduce pool water heating energy requirements by 50%–70% percent, reduce the make-up water needed by 30%–50%, and reduce the pool's chemical consumption by 35%–60%. The pool cover will also reduce the ventilation and dehumidification energy required to control interior moisture loads, and reduce the moisture loads on building assemblies that enclose pools. [1]

Time switches reduce pumping energy use by reducing the run time of a pool filter pump from 24 hours a day to 2 to 3 hours per day. Providing easily accessible manual control for pumps and heaters allow the user to easily save more energy.

[1]U.S. Department of Energy - Energy Efficiency and Renewable Energy, A Consumer's Guide to Energy Efficiency and Renewable Energy, Swimming Pool Covers.

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: **Disapproved**

Committee Reason: This change would create enforcement problems since the owner can put the cover on anytime. This should not apply to indoor pools. Also, there is limited availability of R-12 covers.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Chuck Murray, Washington State University Energy Program, representing Northwest Energy Code Group, requests Approval as Submitted.

Commenter's Reason: The proposed modification was approved by the IECC committee. For consistency, we are seeking approval from the voting membership in the IRC for the reasons stated in the original proposal.

Public Comment 2:

Craig Conner, Building Quality, representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

N1103.7.1 Pool heaters. All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas <u>or LPG</u> shall not have continuously burning pilot lights.

N1103.7.3 Pool covers. Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12.

~~**Exception:** Pools deriving over 60 percent of the energy for heating from site-recovered energy or solar energy source.~~

(Portions of proposal not shown remain unchanged)

Commenter's Reason: *Jurisdictions legitimately expect the I-codes to be an internally consistent family of model codes that they can use as the foundation for their own building code. This change is one of a series of changes intended to correct a large number of inconsistencies in the residential energy requirements in the IECC and IRC. Greater detail is provided in the reason statements for EC6 and RE6.*

EC81/EC82 alignment: EC82 was Approved as Submitted in the IECC, however there was no IRC part submitted. EC81 was Disapproved in the IRC, but is very similar to EC82. <u>To realign the two codes, EC81 in the IRC could be Approved as Modified to be identical to EC81</u>.

EC81 / EC82 content: Both changes require pool heater controls and pool covers. Both changes prohibit a continuous pilot light on the pool heaters. The IECC committee thought this *"a significant opportunity for energy savings".*

Final Action: AS AM AMPC____ D

NOTE: PART I REPRODUCED FOR INFORMATIONAL PURPOSES ONLY – SEE ABOVE

EC81-07/08, Part I – IECC

Add new text as follows:

<u>**403.7 Pools.** Pools shall be provided with energy conserving measures in accordance with Sections 403.7.1 through 403.7.3.</u>

<u>**403.7.1 Pool heaters.** All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.</u>

<u>**403.7.2 Time switches.** Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.</u>

<u>**Exceptions:**</u>

1. <u>Where public health standards require 24-hour pump operation.</u>
2. <u>Where pumps are required to operate solar-and waste-heat-recovery pool heating systems.</u>

403.7.3 Pool covers. Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12.

> **Exception:** Pools deriving over 60 percent of the energy for heating from site-recovered energy or solar energy source.

(Renumber subsequent sections)

Reason: (Same as PART II)

Cost Impact: (Same as PART II)

PART I – IECC **Withdrawn by Proponent**

EC82-07/08

403.7 (New), 403.7.1 (New), 403.7.2 (New), 403.7.3 (New)

Proposed Change as Submitted:

Proponent: Donald J. Vigneau, Northeast Efficiency Partnerships, Inc.

Add new text as follows:

403.7 Pools. Pools shall be provided with energy conserving measures in accordance with Sections 403.7.1 through 403.7.3

403.7.1 Pool heaters. All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas or LPG shall not have continuously burning pilot lights.

403.7.2 Time switches. Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Where pumps are required to operate solar-and-waste-heat-recovery pool heating systems.

403.7.3 Pool covers. Heated pools shall be equipped with a vapor-retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12.

Reason: The change adds the existing commercial pool provisions contained in Section 504.7 as Section 403.7. These provisions were set forth as Section 504.3 in the IECC 1998, 2000 and 2003 residential requirements, taken from the 1995 Model Energy Code, but relocated by DOE in their massive IECC 2004 Supplement proposal to the commercial provisions of the IECC 2004 Supplement, Chapter 8 that had no pool provisions. One requirement has been added prohibiting standing pilot lights on LPG heaters as well as natural gas models.
Since energy conservation compliance can now be made without reliance on ASHRAE 90.1, the requirements are necessary in both chapters, otherwise a whole category of pools in residential occupancies is unregulated. It makes absolutely no sense for pools serving low-rise multiple family dwellings not to be required to conserve energy on the same basis as required in the high-rise apartments next door.

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: **Approved as Submitted**

Committee Reason: The proposal simply adds requirements for residential heated pools that are already included in this code for commercial heated pools. Given the increasing use of heated pools in residences, this is a significant opportunity for energy savings.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Shaunna Mozingo, City of Westminster, CO, representing the Colorado Chapter of the International Code Council, requests Disapproval.

Commenter's Reason: The Colorado Chapter requests disapproval of this item. EC82 07/08 did not have a part II and therefore the IRC B/E committee did not hear this code change proposal.

The results of the Palm Springs hearings have established Chapter 4 of the IECC and Chapter 11 of the IRC as two separate, distinct sets of minimum standards for the same structure, while the physical dynamics are the same in both.

Divergent actions on this item will lead to confusion and inconsistency in code enforcement and construction. Conflicting requirements devalue the benefits of the IRC as an effective stand alone document. When the differences are justified based on technical merit, we can all readily provide a reasonable explanation and achieve code compliance. .

This is one of a series of public comments attempting to bring consistency back to the family of I-codes.

Final Action: AS AM AMPC____ D

EC84-07/08, Part II

IRC R202 (New), N1104 (New), N1104.1 (New), N1104.2 (New)

NOTE: PART I DID NOT RECEIVE A PUBLIC COMMENT AND IS ON THE CONSENT AGENDA. PART I IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY FOLLOWING <u>ALL</u> OF PART II.

Proposed Change as Submitted:

Proponent: Craig Conner, Building Quality, representing himself

PART II – IRC

Add new text as follows:

SECTION R202
GENERAL DEFINITIONS

<u>**DEFINITION: HIGH-EFFICACY LAMPS**: Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:</u>

1. <u>60 lumens per watt for lamps over 40 watts,</u>
2. <u>50 lumens per watt for lamps over 15 watts to 40 watts,</u>
3. <u>40 lumens per watt for lamps 15 watts or less.</u>

<u>**SECTION N1104**</u>
<u>**ELECTRICAL POWER AND LIGHTING SYSTEMS**</u>

<u>**N1104.1 Scope.** This section applies to lighting equipment, related controls and electric circuits serving the interior spaces and exterior building facades of all residential buildings, including accessory structures and garages.</u>

<u>**N1104.2 Lighting equipment.** A minimum of fifty percent of the lamps in permanently installed lighting fixtures shall be high efficacy lamps.</u>

Reason: Lighting is about 12% of primary residential energy, making this requirement a substantial energy saver. The overwhelming majority of residential lighting is incandescent--the least energy efficient of all light types. More efficient lighting options are available.

One more efficient lighting option is the Compact Fluorescent Light (CFL). CFLs have become common and dropped markedly in price. 60 watt replacement CFLs are available for about $1.50 per bulb from multiple sources. (Ikea http://www.ikea.com/us/en/catalog/products/00067731, Wal-Mart http://www.walmart.com/catalog/product.do?product_id=5650618)

CFLs use about 80% less energy than standard incandescent lighting. CFLs last 6 to 10 times longer than incandescent. Assuming a cost of $1.50 per bulb, electricity at 9 cents per kwh, and that each light averages half hour per day of use, then the payback time is less than 2 years. Many lights are used more than an hour per day, yielding paybacks of less than a year.

Limiting this requirement to 50% of the lamps in a residence ensures there will be plenty of exceptions for situations where a CFL might not work as well, such as dimmable fixtures.

Cost Impact: The code change proposal will increase the cost of construction.

PART II – IRC
Committee Action: **Approved as Modified**

Modify proposal as follows:

SECTION N1104
~~ELECTRICAL POWER AND~~ LIGHTING SYSTEMS

~~**N1104.1 Scope.** This section applies to lighting equipment, related controls and electric circuits serving the interior spaces and exterior building facades of all residential buildings, including accessory structures and garages.~~

N1104.~~2~~1 Lighting equipment. A minimum of fifty percent of the lamps in permanently installed lighting fixtures shall be high efficacy lamps.

(Portions of proposal not shown remain unchanged)

Committee Reason: The energy bill mandates deletion of incandescent light bulbs by the year 2012. This change will begin that process ahead of time and will result in a significant energy saving. The modification was made to limit the scope to only lighting equipment.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

James R. Benya, PE, FIESNA, FIALD, LC, Benya Lighting Design, requests Approval as Modified by this Public Comment.

Further modify proposal as follows:

N1104.1 Lighting equipment. ~~A minimum of fifty percent of the lamps in permanently installed lighting fixtures shall be high efficacy lamps.~~

1. **High efficacy luminaires.** High Efficacy Luminaires for residential lighting shall contain only high efficacy lamps and shall not contain a medium screw base socket (E24/E26). A high efficacy lamp has a lamp efficacy that is no lower than the efficacies contained in Table xxx. Ballasts for fluorescent lamps shall be electronic and shall have an output frequency no less than 20 kHz.

    Exception: High intensity discharge luminaires containing hardwired electromagnetic ballasts in medium screw base sockets shall be considered high efficacy luminaires for the purposes of meeting this Section, provided they meet the efficacies contained In Table xxx.

2. **Lighting in kitchens.** At least 50 percent of the total rated wattage of permanently installed luminaires in kitchens shall be in high efficacy luminaires. Separate switches shall be provided for low efficacy luminaires. Lighting in areas adjacent to the kitchen, including but not limited to dining and nook areas, are considered kitchen lighting if they are not separately switched from kitchen lighting.
3. **Lighting in bathroom, garages, laundry rooms, and utility rooms.** Permanently installed luminaires in bathrooms, garages, laundry rooms, and utility rooms shall either be high efficacy luminaires, or shall be controlled by a motion sensor.
4. **Lighting other than in kitchens, bathrooms, garages, laundry rooms, and utility rooms.** Permanently installed luminaires located other than in kitchens, bathrooms, garages, laundry rooms, and utility rooms shall either be high efficacy luminaires, or shall be controlled by a dimmer switch or motion sensor. Permanently installed luminaires that are not high efficacy luminaires shall be allowed in closets less than 70 square feet.
5. **Recessed luminaires in insulated ceilings.** Luminaires recessed into insulated ceilings shall be approved for zero clearance insulation cover (IC) by Underwriters Laboratories or other testing/rating laboratories recognized by the International Conference of Building Officials, and shall include a label certifying air tight (AT) or similar designation to show air leakage less than 2.0 CFM at 75 Pascals (or 1.57 lbs/ft2) when tested in accordance with ASTM E283, and shall be sealed with a gasket or caulk between the housing and ceiling.
6. **Outdoor lighting.** Luminaires providing outdoor lighting and permanently mounted to a residential building or to other buildings on the same lot shall either be high efficacy luminaires or shall be controlled by a motion sensor(s) with integral photocontrol. Permanently installed luminaires in or around swimming pools, water features, or other locations subject to Article 680 of the National Electrical Code need not be high efficacy luminaires.
7. **Parking lots and garages.** Lighting for parking lots for eight or more vehicles shall comply with the applicable requirements for non residential lighting.
8. **Common areas of low-rise residential buildings.** Permanently installed lighting in the enclosed, non-dwelling spaces of low-rise residential buildings with four or more dwelling units shall either be high efficacy luminaires or shall be controlled by an occupant sensor(s).

TABLE XXX

Rated Lamp Watts (fluorescent or compact fluorescent) or LED rated watts including driver.	Lamp Efficacy (initial lumens per rated lamp)
5 watts or less	30
Over 5 watts to 15 watts	40
Over 15 watts to 40 watts	50
Over 40 watts	60

Commenter's Reason: Since the mid-1980's California has required residential lighting efficiency and the proposed language above is an abbreviated version of the current California Title 24 Part 6 Section 150 requirements. With over 20 years of enforcement experience, California has learned many important lessons embodied in this language including the many possible "cheats" and "gaming" that can occur with language as loose as the original IECC proposal. Carefully written and tested wording assures the best possible compliance and perseverance of efficient lighting. Moreover, it makes considerable sense for the nation to have a single set of rule for residences so that manufacturers, designers and builders can learn together and achieve at a national level the success of California in this area.

Additional reasons for further modification:

- The Federal Energy Security and Independent Act of 2007 does NOT delete the incandescent lamp. Incandescent lamps are not effectively banned until 2020.
- The original proposal would result in snapback, with medium screw based compact fluorescent lamps installed until the inspection is complete. The goal will not be met.
- The original proposal does not address energy, but simply watts. Numerous studies have shown that more energy is saved by motion sensors in key residential applications.

Bibliography

California Energy Commission, 2005 ***Energy Efficiency Standard***s, Section 150 (k).

Note that some of the 2008 requirements have been included but due to the complex language of the 2008 standard, the 2005 language is mostly used in this proposal

Final Action: AS AM AMPC____ D

EC85-07/08

Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

Revise table as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Glazing [a]	Total area [b] = (a) The proposed glazing area; where the proposed glazing area is less than 18% of the conditioned floor area (b) 18% of the conditioned floor area; where the proposed glazing area is 18% or more of the conditioned floor area	As proposed
	Orientation: equally distributed to four cardinal compass orientation (N,E,S, & W)	As proposed
	U-factor: from Table 402.1.2	As proposed
	SHGC: From Table 402.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	Interior shade fraction: Summer (all hours when cooling is required) = ~~0.70~~ 0.90 Winter (all hours when heating is required) = ~~0.85~~ 0.90	Same as standard reference design [c]
	Exterior shading: none	As proposed

(Portions of table and footnotes not shown remain unchanged)

Reason: This proposal alters the assumptions regarding interior window shades in the standard reference design. It assumes that a typical occupant will not alter their behavior with regards to interior shade operation by season. It also assumes that the majority of windows will not have shades drawn during daytime hours to block solar radiation. As a result, the purchased energy estimated using the performance approach will be more accurate and representative of an actual residential building.

This proposal makes the performance path more accurate by assuming an equal interior shade fraction in all seasons. The current standard reference design assumes that 30% of the solar gain in the summer has already been blocked by shade use, while only 15% is blocked in the winter. Because the performance path assumes that interior shading is used twice as much in the summer as in the winter, the equation shows higher relative energy use in the heating months than in the cooling months. In the performance path calculation, this translates to an artificially inflated heating budget and a bias in favor of measures used to reduce heating energy. The assumption also makes no climate zone-specific distinctions, but rather assumes that shading tendencies are static nationally. The result is that the performance path may favor compliance measures that reduce heating energy over measures that reduce cooling energy, even in cooling-dominated climates.

Although it can be argued that a conscientious building occupant may reduce heating or cooling loads by operating shades to minimize sunlight during the summer and maximize sunlight during winter, there is no data to suggest that occupants actually engage in these practices for the purpose of saving energy. In fact, it is common practice in northern climates to use shades more often during the winter months for the perceived insulating benefits and to control glare. There are many reasons why shades are operated throughout the year, and almost all of them have nothing to do with energy use. For example, privacy concerns may lead occupants to leave shades closed year-round, whereas a beautiful view or day-lighting interest may induce an occupant to leave shades open year-round. Every building will have unique shading characteristics based on the climate zone, shade type, window type, orientation, exterior shading, and most importantly, the occupant's priorities.

Because there is no reliable data to support the current bias in the performance path, the shading fraction should be neutralized so that heating and cooling measures will be treated similarly. Moreover, given that lack of data as to actual operation, the safer assumption is that shades are largely left open (justifying a higher fraction); after all, it is reasonable to assume that the average person buys windows for views and light. This is the only solution that makes sense, given the wide range of climate zones and circumstances to which the performance path will apply. This change is not intended to affect the overall stringency of the code, nor should it generally increase the costs of compliance.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Disapproved

Committee Reason: There is no technical support for changing assumptions about human behavior relative to use of windows in different seasons. These numbers are higher than ASHRAE 92 and, while that is not necessarily a reason not to change them, there needs to be more study to justify the assumptions.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Steven Rosenstock, Edison Electric Institute, Harry Misuriello, American Council for Energy Efficient Economy, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 404.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Glazing [a]	Total area [b] = (c) The proposed glazing area; where the proposed glazing area is less than 18% of the conditioned floor area (d) 18% of the conditioned floor area; where the proposed glazing area is 18% or more of the conditioned floor area	As proposed
	Orientation: equally distributed to four cardinal compass orientation (N,E,S, & W)	As proposed
	U-factor: from Table 402.1.2	As proposed
	SHGC: From Table 402.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	Interior shade fraction: Summer (all hours when cooling is required) = ~~0.90~~ 0.85 Winter (all hours when heating is required) = ~~0.90~~ 0.85	Same as standard reference design [c]
	Exterior shading: none	As proposed

Commenter's Reason: EC85 is part of the EECC's proposed package to improve the IECC residential energy provisions by 30%. As explained in detail in the reason for the original proposal, EC85 allows for the energy efficiency improvements of the home to be treated consistently throughout the year without impact from occupant behavior between seasons. In the existing *IECC*, it is assumed that shading is used more in the summer than the winter, thereby reducing the benefits of measures aimed at conserving cooling energy (because cooling energy has already been reduced by the assumption of greater shading). If EC85 is adopted, this assumption will be removed and simulated performance analysis will no longer be artificially biased. In order to make this proposal more acceptable, this public comment modifies the interior shade fractions to 0.85 year round to be consistent with currently accepted value of 0.85 for winter in the 2006 IECC.

The Development Committee noted that: "There is no technical support for changing assumptions about human behavior relative to the use of windows in different seasons." We submit that there is no technical support for any specific assumption about human behavior in operating shades in home. However, the present code assumes that shades are used twice as much during the summer as the winter. Because there is no valid evidence as to actual human behavior, and indeed shade use is ultimately up to each individual occupant, we propose to treat all seasons equally. In order to satisfy the concerns of the committee, we propose to modify the proposal to use a shading value (0.85) already contained in the code.

Final Action: AS AM AMPC____ D

EC86-07/08

Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

Revise table as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Thermostat	Type: Manual, cooling temperature setpoint = ~~78~~ 75°F; Heating temperature set point = ~~68~~ 70 °F	Same as standard reference

(Portions of table and footnotes not shown remain unchanged)

Reason: This code change modifies the thermostat set points assumed in the standard reference design to reflect more realistic and more conservative values. There is no persuasive evidence that the current assumptions of 78°F in cooling months and 68°F in heating months are representative of actual occupant practice nationwide. Actual set points vary widely according to occupant comfort, climate, and other considerations, and it would be difficult to select a single set of values for the entire country. However, these set points are critical in the performance path because they determine the relative levels of heating and cooling energy used in the building. A builder or designer's choices to include measures to reduce heating or cooling energy in the home will be driven by the outcome of this equation, so it is imperative that the assumptions match reality. Given these issues, the best approach is to assume conservative numbers, not the "best case" figures currently in the performance path.

The proposed change accomplishes this objective by changing the assumed thermostat set points by two degrees for heating periods (70°F) and three degrees for cooling periods (75°F). These set points are more consistent with comfort considerations and are closer to the set points currently used for HVAC sizing (70°F heating, 75°F cooling). The result will be a more accurate analysis of energy use in homes complying under the simulated performance alternative. This change is not intended to affect the overall stringency of the code, nor should it generally increase the costs of compliance. It will, however, provide a more reasonable indication of the likely impacts of various choices on overall energy use and cost effectiveness.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: **Approved as Modified**

Modify the proposal as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature set point = ~~70~~ <u>72</u> °F	Same as standard reference

(Portions of table and footnotes not shown remain unchanged)

Committee Reason: The numbers proposed are more realistic. The modification was requested by the proponent as a compromise number.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Thomas D. Culp, Birch Point Consulting LLC, representing himself, requests Disapproval.

Commenter's Reason: EC86 proposes typical operating temperature setpoints for the performance calculation which are simply incorrect. First, the proposed 75°F cooling temperature and 72°F heating temperature are used in Section 302.1 as the design conditions for HVAC sizing. However, it is obviously wrong to assume that sizing design conditions are the same as typical operating conditions … you don't design for a 90 mph wind load and then assume the wind blows at 90 mph all the time in real life!

Furthermore, there is no technical justification for the 75°F cooling setpoint, whereas there is significant precedent for the current 78°F:

1. 78°F is specified in the Code of Federal Regulations 10CFR435(c), Mandatory Performance Standards for New Federal Residential Buildings, so anything different will makes the IECC inconsistent with this federal regulation.
2. 78°F is used in RESNET for HERS performance calculations.
3. 78°F is used in ASHRAE 90.2 for performance calculations.
4. 78°F was corroborated by a Florida Solar Energy Center study in 1999 of 170 homes in central Florida. (D. Parker, Florida Solar Energy Center, "Research Highlights from a Large Scale Residential Monitoring Study in a Hot Climate", presented at the International Symposium on Highly Efficient Use of Energy and Reduction of its Environmental Impact, Japan Society for the Promotion of Science Research for the Future Program, Osaka, Japan, January 2002)
5. 78°F was corroborated by a study of occupant behavior and indoor conditions done for the California Energy Commission in 1992 by the Berkeley Solar Group and Xenergy.
6. 78°F balances those occupants who use lower setpoints against those homes whose occupants are not home during the day, only have room air conditioners, or set up the thermostat during the day.

In contrast, no data has been presented to substantiate the proposed 75°F operating temperature. It is simply an arbitrary guess by the proponents based upon their subjective view of "comfort". I ask your disapproval of EC86.

Public Comment 2:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The standard reference design setpoints should represent the average setting in a household (which they are currently) not an HVAC worst case design condition (which is being proposed). There is no evidence that there is a problem needing corrected.

NAHB urges your disapproval on this proposal.

Public Comment 3:

Thomas S. Zaremba and Tom Mewbourne, Pilkington North America, Inc. and AGC Flatglass North America, Inc., representing same, requests Disapproval.

Commenter's Reason: The changes proposed by EC86-07/08 are completely subjective and, thus, arbitrary. The Committee's decision to adopt EC86 as modified is equally arbitrary and violative of the rules governing these code development proceedings. Rule 3.3.4.3 of CP#28-05 governing these proceedings clearly provides that: "**the proponent shall substantiate the proposed code change based on technical information and substantiation**." (Emphasis added). In this case, however, the Proponent was forced to concede during the Committee hearing that the changes proposed to the thermostat setpoints were completely subjective, and not supported by any technical information or substantiation.

It is equally evident that the Committee's decision to adopt this proposal as modified lacks any technical justification. In that regard, the Committee Reason for Approval as Modified states: "This modification was requested by the proponent as a **compromise number**." (Emphasis added.)

Changing the thermostat setpoints of the standard reference design can have a dramatic effect on calculations used to determine the energy efficiency of one product over others. Compromises that can favor one product over others in the marketplace are unacceptable. Numbers that affect the selection and use of products should only be changed in strict compliance with the rule that mandates that code changes be based on adequate technical justification.

No technical justification exists to change the thermostat setpoints of the standard reference design and I urge you to vote against the motion to sustain the Committee recommendation to approve as modified and to vote to disapprove EC86-07/08.

Final Action: AS AM AMPC____ D

EC87-07/08
Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

Revise table as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3 Solar absorptions = 0.75 Remittance = 0.90	As proposed As proposed As proposed, <u>assuming gaps/missing insulation equal to 5%, unless otherwise verified</u> As proposed As proposed
Basement and crawlspace walls	Type: same as proposed Gross Area: same as proposed U-Factor: from Table 402.1.3, with insulation layer on interior side of walls	As proposed As proposed As proposed, <u>assuming gaps/missing insulation equal to 5%, unless otherwise verified</u>
Above-grade floors	Type: wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3	As proposed As proposed As proposed, <u>assuming gaps/missing insulation equal to 5%, unless otherwise verified</u>
Ceilings	Type: wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3	As proposed As proposed As proposed, <u>assuming gaps/missing insulation equal to 5%, unless otherwise verified</u>

(Portions of table not shown remain unchanged)

<u>a. Insulation installation, including percent of insulation missing and insulation substantially filling cavity and, shall be determined and documented by an independent party approved by the code official.</u>

(Reletter a. through k. to become b. through l.)

Reason: This proposal recognizes that insulation must be installed per the manufacturer's specifications for it to perform as expected. EPA's ENERGY STAR Qualified New Homes program, RESNET, and others, have also recognized this distinction and incorporated requirements for insulation to be inspected to determine its level of performance. Similar to RESNET's requirements, this proposal requires that proposed homes assume decreased insulation performance equivalent to insulation gaps in 5% of the component surface area unless otherwise verified. Assuring proper installation of insulation is one of the most cost effective opportunities to improve the efficiency and comfort of new homes.

The residential building energy efficiency requirements in ICC codes have not had an overall substantial national improvement in many years. During that time, fuel prices have increased dramatically and environmental concerns from energy usage (notably global warming) have come to the forefront. Improving residential new construction energy efficiency is one of the most cost-effective ways to reduce consumption within the country. This proposal represents a reasonable and cost effective improvement that will provide states and local jurisdictions with an option to easily increase the efficiency of their code.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: **Approved as Modified**

Modify the proposal as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3 Solar absorptions = 0.75 Remittance = 0.90	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified As proposed As proposed
Basement and crawlspace walls	Type: same as proposed Gross Area: same as proposed U-Factor: from Table 402.1.3, with insulation layer on interior side of walls	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5% <u>of the insulated surface area</u>, unless otherwise verified
Above-grade floors	Type: wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5% <u>of the insulated surface area</u>, unless otherwise verified
Ceilings	Type: wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5% <u>of the insulated surface area</u>, unless otherwise verified

(Portions of table not shown remain unchanged)

a. Insulation installation, including percent of insulation missing and insulation substantially filling cavity and, shall be determined and documented by <u>the code official or</u> an independent party approved by the code official.

Committee Reason: It is realistic to assume in common practice that gaps or missing insulation will exist. If tighter inspection is made, then the user can take advantage of that, and get credit for more insulation. The modifications are for clarity, and to make clear that the code official can make the determination of installation.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Ron Nickson, National Multi Housing Council, requests Disapproval.

Commenter's Reason: The proposal as approved places a 5% penalty on the calculated values for the proposed design when using the simulated performance alternative for compliance. This assumes that the insulation in the performance building would not be installed properly and that the insulation in the standard reference building would be installed properly. That is an workmanship issue which is not an issue that can be controlled by the code. This change should be disapproved so that the calculations for the simulated performance alternative are on the same base as the standard reference design.

Public Comment 2:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: Insulation inspections are already required by the building official. This will put the inspector or code official in the awkward situation of assigning a very specific grade to an insulation inspection based on very subjective criteria that is not even available in the code, but will require getting the criteria from the Residential Energy Services Network. Baseline missing insulation of 5% is a completely unsubstantiated baseline. How often does a 2,000 square foot attic have 100 square feet of attic floor with completely missing insulation? This would also be the assumed missing percent in attics, walls and floors. Five percent missing insulation would not pass currently, why should this option be given? NAHB Requests your disapproval on this proposal.

Public Comment 3:

Larry Williams, Steel Framing Alliance, requests Disapproval.

Commenter's Reason: The IECC committee approved this as modified. It unnecessarily requires a designer, inspector, or building plan reviewer to assume that 5% of the insulation is missing or consists of gaps when using the simulated performance alternative permitted under Section 404 of the code. The only alternative the proponents would recognize is when the installation is otherwise verified.

Jurisdictions have competent and professional inspectors whose job is to evaluate not only the base code requirements but also ensure that work is done to ensure good quality of installation. Requiring a conservative assumption is just not necessary for the installation of insulation. Gaps should be corrected before the building is closed in. Further, the proponents did not consider that the use of continuous exterior insulation would not suffer from the same types of gaps they perceive to exist with cavity insulation.

Finally, the term "unless otherwise verified" is vague and possibly unenforceable. It is not clear if this would require a special additional inspection or if the building inspector can verify the installation.

Final Action: AS AM AMPC____ D

EC88-07/08

Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

Revise table as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air Exchange Rate	Specific Leakage Area (SLA)[d] = 0.00036 assuming no energy recovery.	For residences that are not tested, ~~the same as the standard reference design~~ 0.00060 SLA assuming no energy recovery For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate [e] but not less than 0.35 ACH For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate [e] combined with the mechanical ventilation rate, [f] which shall not be less than 0.01 x CFA + 7.5 x (Nbr+1) where: CFA = conditioned floor area Nbr = number of bedrooms

(Portions of table and footnotes not shown remain unchanged)

Reason: This proposal dictates a higher default leakage level in the proposed home than the standard reference home, but does not make any changes to the standard reference design. This is one of two proposals addressing this subject; the second proposal also tightens the standard reference design.

The current code assumes that where residences are not tested, that the default air leakage level should be equal to the standard reference design. We believe that it is unreasonable to assume, with no proof, that every home meets the requirements of the standard reference design.

Prior to the 2004 IECC the equivalent specific leakage area used in energy analysis was approximately 0.00060, with an air change rate of 0.57 x W, the 2004 IECC set the first exact specific leakage area requirement at 0.00048, and then the 2006 IECC further reduced the specific leakage area to 0.00036. This proposal sets the proposed design default value at approximately equal to the previous infiltration air change rate of 0.57 x W, with a 0.00060.

If this proposal is adopted, builders using the performance path for compliance will be encouraged to tighten and test their homes to demonstrate savings over the current standard reference design. As currently adopted, the code provides no incentive for builders to test, because the proposed home dictates an extremely low level of infiltration by default. Therefore, builders are perversely encouraged to not test their home, because doing so would likely decrease the amount of savings that can be claimed.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: **Disapproved**

Committee Reason: This proposal would add costs to construction without a strong justification.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Steven Rosenstock, Edison Electric Institute, Harry Misuriello, American Council for Energy Efficient Economy, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 404.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air Exchange Rate	Specific Leakage Area (SLA)[d] = 0.00036 assuming no energy recovery.	Specific Leakage Area (SLA)[d] = the tested value for the proposed home and ~~For residences that are not tested, 0.00060 SLA assuming no energy recovery~~ the tested value shall be in accordance with the ASHRAE 119, Section 5.1 and the SLA shall be: 1. For residences without mechanical ventilation ~~that are tested in accordance with ASHRAE 119, Section 5.1,~~ the measured air exchange rate[e] but not less than 0.35 ACH 2. For residences with mechanical ventilation ~~that are tested in accordance with ASHRAE 119, Section 5.1,~~ the measured air exchange rate[e] combined with the mechanical ventilation rate,[f] which shall not be less than 0.01 x CFA + 7.5 x (Nbr+1) where: CFA = conditioned floor area Nbr = number of bedrooms

Commenter's Reason: The opportunity to save energy by reducing and controlling air leakage is very large throughout the country. EC88, as originally written, recognizes that potential and requires that a user of the performance path either the test the air leakage or use a default value that more closely represents the likely air leakage without testing. In short, we thought it was reasonable that the code not simply assume that the home will meet the code standard, but rather either require a test to prove that it meets the standard or, in the alternative, apply a default reflecting weaker performance.

A slight majority of the *IECC* Development Committee voted for disapproval on the general grounds that the "proposal would add costs to construction without a strong justification." Presumably the increase to the cost of construction referenced is the cost of a test. After all, EC88 does not change the stringency of the standard that homes have to meet (0.00036 SLA). We believe that the cost of testing is insignificant when compared to the potential energy savings of a reasonably tight home. We estimate that requiring all homes to meet an SLA of 0.00036 will improve the efficiency of homes in the range of 3-9% in purchased energy (heating, cooling and hot water).

As a result, the proposed modification eliminates the default option and simply requires the use of tested air leakage values in the performance path. This requirement for testing, similar to the testing requirement that was approved by the committee for ducts, creates another large energy efficiency opportunity. In addition, this comment is consistent with our proposal to modify EC64 in public comment, which will require air leakage testing for the prescriptive path; this proposal correspondingly requires testing for the performance path.

Final Action: AS AM AMPC____ D

EC90-07/08
Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

Revise table as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air Exchange Rate	Specific Leakage Area (SLA)[d] = ~~0.00036 assuming no energy recovery~~ 0.00015 combined with the mechanical ventilation rate, which shall be 0.01 x CFA + 7.5 x (Nbr+1) where: CFA = conditioned floor area Nbr = number of bedrooms and assuming continuous balanced ventilation using a energy/heat recovery ventilator with a recovery efficiency of 76% [f]	For residences that are not tested, ~~the same as the standard reference design~~ 0.00060 SLA assuming no energy recovery For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate [e] but not less than 0.35 ACH For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate [e] combined with the mechanical ventilation rate, [f] which shall not be less than 0.01 x CFA + 7.5 x (Nbr+1) where: CFA = conditioned floor area Nbr = number of bedrooms

(Portions of table and footnotes not shown remain unchanged)

Reason: This proposal dictates a higher default leakage level in the proposed home than the reference home. In addition, it dictates a low infiltration value in the reference home and adds an active ventilation system with heat/energy recovery. This is the second, more stringent of two proposed alternative proposed for consideration related to air leakage.

The proposed configuration for the standard reference home represents a home that is “built tight, and ventilated right”, a common objective of good building science. The low infiltration value represents achievable leakage by following the prescriptive guidance in this code.

The current code assumes that where residences are not tested, that the default air leakage level should be equal to the standard reference design. We believe that it is unreasonable to assume, with no proof, that every home meets the requirements of the standard reference design.

Prior to the 2004 IECC the equivalent specific leakage area used in energy analysis was approximately 0.00060, with an air change rate of 0.57 x W, the 2004 IECC set the first exact specific leakage area requirement at 0.00048, and then the 2006 IECC further reduced the specific leakage area to 0.00036. This proposal sets the proposed design default value at approximately equal to the previous infiltration air change rate of 0.57 x W, with a 0.00060.

If this proposed code modification is adopted, builders who use the performance path for compliance will be encouraged to tighten and test their homes to demonstrate savings. As currently adopted, the code provides no incentive for builders to test, because the proposed home dictates an extremely low level of infiltration by default. Therefore, builders are perversely encouraged to not test their home because doing so would likely decrease the amount of savings that can be claimed.

Cost Impact: The code change proposal will increase the cost of construction. The initial cost of this improvement may be higher, but the long-term energy savings outweigh these costs.

Committee Action: **Disapproved**

Committee Reason: The proposal was disapproved in accordance with the proponent’s request.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Steven Rosenstock, Edison Electric Institute, Harry Misuriello, American Council for Energy Efficient Economy, requests Approval as Submitted.

Commenter's Reason: EC90 creates an incentive for builders to install high-efficiency HVAC equipment and closes a compliance loophole for low-efficiency equipment. Although EC 91 as approved by the *IECC* Committee is preferable, EC90 is also a reasonable approach. This public comment is submitted to allow EC 90 to be considered at the final action hearing as a possible alternative to EC 91, should the ICC membership prefer this option. It should be noted that if either EC 90 or EC 91 is adopted, it would not affect the use of HVAC trade-offs to meet voluntary programs such as Energy Star Homes or the tax credit.

Closes a Compliance Loophole. Like EC 91, EC 90 addresses one of the largest barriers to increasing the energy efficiency requirements in the *IECC*. Heating, cooling and hot water heating equipment minimum efficiencies are currently set by the federal government and states are preempted from requiring higher standards in state energy codes. The process for setting the federal minimums takes years, even decades, and market practice often outpaces the federal minimum requirement. For example, the federal minimum efficiency for natural gas-fired furnaces is currently only 78%, and will increase to only 80% a number of years from now. In most climates, builders are already installing far more efficient furnaces to meet consumer demand. Unfortunately, for homes built with more efficient heating equipment, the *IECC* performance path allows the builder to trade away efficiency in the permanent thermal envelope, *even though the more efficient furnace would have been installed anyway and even though the useful life of the furnace is far less than the useful life of typical envelope measures*.

Offers an Incentive to Install Efficient HVAC Equipment. Although EC 90 shares the same purpose as EC 91, EC 91 offers the most complete solution to the HVAC loophole by completely eliminating the reference to federal minimums. By contrast, EC 90 leaves equipment trade-offs in the IECC performance path, and leaves the federal minimum efficiencies in the standard reference design. However, EC 90 does not award any trade-off credit unless a home's HVAC system is 15% more efficient (or more) over current federal minimums. In short, EC 90 rewards builders for true enhancements to energy efficiency, rather than simply creating unnecessary trade-off credit as in the current code.

Helps Consumers Struggling with Skyrocketing Energy Costs. Residential energy efficiency in states that adopt the *IECC* cannot move forward without eliminating unnecessary credit for sub-par heating and cooling systems. Federal minimums have not kept pace with energy cost increases or modern building practice. The last time the federal minimum efficiency was set for natural gas furnaces (78% efficiency) in 1992, the yearly average natural gas price at the wellhead was $1.74 per thousand cubic feet. By 2007, the yearly average price reached $6.39 per thousand cubic feet, and is much higher now. *That is a 367% increase in natural gas costs, with a 0% increase in federal minimum furnace efficiency*. The *IECC* simply cannot afford to wait for better federal minimum efficiencies and such minimums, often far below typical practice, should not be allowed to generate artificial trade-off credit. If our nation truly intends to move toward more energy independence, we need to address the efficiency of HVAC equipment in residential homes. Unfortunately, the building/energy code is preempted from addressing this issue by requiring more efficient HVAC systems. As a result, the code must be amended to remove credit for putting in systems that are sub-par or at best should only be setting the minimum level of efficiency.

We urge approval of EC 91 because it is the most complete solution to the HVAC loophole; as a fallback, we offer EC 90 as an alternative acceptable solution.

Final Action: AS AM AMPC____ D

EC91-07/08
Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

Revise table as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems[h, i]	As Proposed ~~Fuel type: same as proposed design~~ ~~Efficiencies:~~ ~~Electric: air-source heat pump with prevailing federal minimum efficiency~~ ~~Nonelectric furnaces: natural gas furnace with prevailing federal minimum efficiency~~ ~~Nonelectric boilers: natural gas boiler with prevailing federal minimum efficiency~~ Capacity: sized in accordance with Section M1401.3 of the *International Residential Code*	As Proposed ~~As proposed~~ ~~As proposed~~ ~~As proposed~~ ~~As proposed~~ ~~As proposed~~
Cooling systems[h, j]	As Proposed ~~Fuel type: Electric~~ ~~Efficiency: in accordance with prevailing federal minimum standards~~ Capacity: sized in accordance with Section M1401.3 of the *International Residential Code*	As Proposed ~~As proposed~~ ~~As proposed~~ ~~As proposed~~
Service Water Heating[h, k]	As Proposed ~~Fuel type: same as proposed design~~ ~~Efficiency: in accordance with prevailing federal minimum standards~~ Use: ~~gal/day=30 + (10 x N_{br})~~ Same as proposed design	As Proposed ~~As proposed~~ ~~As proposed~~ ~~Same as standard reference~~ Use: gal/day=30 + (10 x N_{br})

(Portions of table and footnotes not shown remain unchanged)

Reason: This proposed modification will enhance the performance path, improve its accuracy, and increase energy efficiency and stringency by eliminating a significant compliance loophole. This is one of two alternative proposals intended to mitigate the harmful aspects of equipment trade-offs against other energy efficiency features. The proposed change will set the standard reference design for heating, cooling and service water heating the same as the proposed equipment, thereby eliminating trade-offs of such equipment against other energy features of the home.

Under the existing code, the Standard Reference Design references federal minimum standards for heating and cooling systems and service water heating, whereas the efficiencies of the proposed design are entered according to the actual mechanical equipment. The practical effect of specifying the federal minimum efficiencies in the performance path is that the proposed design receives trade-off credit for any upgrade to equipment, no matter how minor, even if the prevailing practice in a climate zone is to install more efficient equipment. At the same time, the ICC has little ability to set a higher standard reference design level to account for improvements because of federal legal preemption concerns.

Since the ICC does not control the federal minimums (which are, indeed, not referenced standards) and states and local jurisdictions generally cannot set higher values in the standard reference design (due to federal preemption concerns), these items should not be included in the code as a basis to trade-off other items that the IECC can control. It simply does not make sense for the IECC to incorporate equipment efficiencies over which states have no control, especially where those efficiencies translate into lower energy efficiency elsewhere in the code. Right now, in regions where higher-efficiency equipment is already likely to be installed, a home built under the prescriptive path (which does not allow equipment trade-offs) may be significantly more efficient than a home built under the performance path (which assumes a worst-case efficiency in the standard reference design for this equipment and then allows off-setting trade-offs elsewhere in the building). For example, in many northern states, furnace efficiencies above 90 AFUE are the norm, yet the performance path gives trade-off credit based on a 78 AFUE federal minimum furnace level established many years ago that may no longer even be available in that market. This can allow a 10% or more increase in heating and cooling energy use from the trade-off of other aspects of the energy efficiency of the home.

Moreover, equipment trade-offs, on their face, typically result in less efficiency. The useful life of HVAC or service water heating equipment is far shorter than envelope components such as insulation or windows. When equipment fails, it may very well be replaced with less efficient equipment.

The solution for the IECC is to make the system efficiency in the standard reference design match the proposed design. More efficient equipment is regularly installed in many states, and should be encouraged, but the current equation in the performance path gives incentives to upgrade equipment at the expense of other efficiency measures, such as thermal envelope components. Unless DOE can suggest a solution that would allow states to require higher equipment efficiencies in the standard reference design, these standards should be removed from the equation.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Approved as Submitted

Committee Reason: The proposal will reduce trade-offs available for measures with shorter life spans. As pointed out in the proponent's reason statement, there is no guarantee that a furnace will not be replaced with a less efficient one when it needs to be replaced.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Deborah Taylor, New York City Department of Buildings, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 404.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems[h, i]	As Proposed Capacity: sized in accordance with the requirements of the *International Mechanical Code*, or Section M1401.3 of the *International Residential Code*	As Proposed
Cooling systems[h, j]	As Proposed Capacity: sized in accordance with the requirements of the *International Mechanical Code*, or Section M1401.3 of the *International Residential Code*	As Proposed

(Portions of proposal not shown remain unchanged)

Commenter's Reason: If a jurisdiction is using *the International Residential Code*, then this provision is already covered in IRC Chapter 11. Provisions in IECC Chapter 4 exist primarily for jurisdictions that do not adopt the IRC and therefore should primarily reference the other I Codes as appropriate.

Public Comment 2:

Thomas D. Culp, Birch Point Consulting LLC, representing the Aluminum Extruders Council, requests Disapproval.

Commenter's Reason: Simply put, this proposal violates common sense: why would you remove the incentive for installing higher efficiency equipment? Installing higher efficiency equipment is a legitimate and cost effective method for improving building performance. Removing the ability to take credit for this improvement in Section 404 violates the whole premise of the performance path, and may lead to unintended consequences. For example, with this proposal, there would be absolutely no incentive to install a SEER 14 or 15 air conditioner anymore, so the net effect would be that only the federal minimum (SEER 13) would be installed.

The proponents argue that HVAC equipment has a shorter life span than envelope components, and that any equipment replaced in the future will be less efficient. Again, this defies common sense. The lifetime of different types of residential HVAC equipment typically ranges from 12-25 years. Over that time period, the increased attention to energy concerns, increasing energy prices, and changes in federal minimum standards would lead to equivalent or increased equipment efficiency – certainly not lower efficiency. Providing an incentive to install high performance equipment is fundamental to a strong energy code, so we strongly request your disapproval.

Public Comment 3:

William E. Koffel, P.E., Koffel Associates, Inc., representing the Glazing Industry Code Committee, requests Disapproval.

Commenter's Reason: Encouraging better HVAC equipment efficiency is essential to improving the overall energy performance of buildings. However, this proposal would do the exact opposite by removing all credit in the performance path for installing higher efficiency equipment. One motivation of the proponents seems to be that they are unhappy with current federal minimum efficiencies set by the National Appliance Energy

Conservation Act (NAECA). Therefore, they wish to simply rely only on the building envelope for energy efficiency while ignoring HVAC equipment performance. While we agree that NAECA needs to be aggressively updated, it is simply the wrong approach for the code to ignore one of the most important aspects controlling the overall energy efficiency of a building.

Public Comment 4:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: This proposal does not give credit for higher-efficiency appliances as a trade-off for building or water heating using the performance method. What are the proponents trying to do? Are they promoting high efficiency equipment or are they promoting energy conservation. This proposal is hard to tell. The proponent is overly concerned that an old furnace could be replaced with a less efficient furnace. This statement could not be any further from the truth. Any furnace purchased today would be more efficient than a furnace purchased 5 -10 15 yrs ago. This reasoning lacks credibility.

Public Comment 5:

Larry Williams, Steel Framing Alliance, requests Disapproval.

Commenter's Reason: The IECC committee approved this as submitted. One reason given by the proponent is that it eliminates a "loophole" in the performance approach that allows the use of Federal minimum efficiency standards for the heating, cooling, and water heating equipment in the standard reference design. If we take the proponents views without exception, we would effectively be stating that any attempt to conduct trade-offs using the performance approach amounts to using a loophole to comply with the code.

The purpose of the performance approach is to provide flexibility in complying with the code. This proposal, if upheld, would take away two of the most significant items – HVAC and water heating equipment – where a designer or builder could find incentive to increase efficiency. It begins to render the performance option as a non-option since there is little benefit to using it if all of the flexibility is systematically removed by this and other proposals approved by the IECC committee.

This proposal will discourage the use of more energy efficient equipment.

Public Comment 6:

Ted A. Williams, American Gas Association, requests Disapproval.

Commenter's Reason: According to the proponent's Reason, the proposal is intended to close "a significant compliance loophole" in the IECC performance path by eliminating credit for installing higher efficiency heating systems and service water heating systems. In receiving no credit on equipment, it is suggested, builders would have to install other energy efficiency features. In doing so, however, the change will encourage builders to install <u>the minimum efficiency equipment allowed</u> to reduce installed costs. The change will, thus, have the unintended consequence of eliminating as options some of the most objective, verifiable means of saving energy: installing more efficient equipment. As a result, the proposal might even serve to increase energy consumption over the current language if builders are not incentivized to install higher efficiency equipment. This ill-conceived approach for the performance path makes the IECC less of a performance capable code overall, which is not in the interest of ICC.

Public Comment 7:

Thomas S. Zaremba and Craig Conner, Roetzel & Andress and Building Quality, representing The Advanced Building Coalition, requests Disapproval.

Commenter's Reason: EC91-07/08 would entirely delete equipment efficiency for heating, cooling and service water systems from the Standard Reference Design, which forms the basis of the IECC's alternate performance path. The use of high efficiency equipment is a legitimate and cost-effective way to achieve high levels of energy efficiency. Removing consideration for equipment efficiency from the performance path eliminates a significant element of design flexibility that is now a part of the IECC.

The IECC's prescriptive requirements serve those that only wish to build, rather than design, buildings. The IECC's alternate path provides for a way to build an energy-efficient but different type of building for the innovative and imaginative. Deleting a designer's flexibility to install more efficient heating, cooling and service water systems, and then trade-off those savings for more innovative designs in the building envelope would be a serious blow to building design.

The Committee supported this proposal on the basis that heating, cooling and service water systems may have useful lives that are shorter than the rest of the building. The reason for the Committee support, however, does not justify deleting the building elements from the standard design. Heating, cooling and service water systems are very real components of buildings that use a significant amount of the total energy profile of the building. Eliminating high efficiency equipment from the performance path does not correct any problem that the Committee may have perceived, except for different lifetimes. In many cases, the lifetimes of other building components are less than the full life of the building; for example, caulking may not last 50 years and windows are often replaced before a building's lifetime is over. Energy-efficient equipment will often be replaced by similar energy-efficient equipment; for example, a condensing furnace (AFUE 90 or more) requires a specific type of chimney so that there is substantial motivation to replace a condensing furnace with another condensing furnace to avoid constructing a new chimney. Ground source heat pumps are highly efficient in the proper climates. If components fail in a ground source heat pump, those components will likely be replaced rather than installing a different and less efficient system.

Currently the code discourages electric resistance heating by requiring it to be compared to the more efficient heat pumps. This change would remove the disincentive for electric resistance heating.

This change would discourage using many highly efficient systems as part of an energy-efficient design. This change requires whatever equipment is installed be presumed as the "base case", so that high efficiency equipment did not offer any advantage in code compliance. Would we presume a system that relies heavily on solar energy would provide no advantage to the residence? Why should a ground source heat pump not be credited with its high level of efficiency? Should the energy-efficient advantages of a tankless water heater or a desuper heater for heating water be ignored? Do we ignore the benefits of a renewable-based system because it is presumed in the Standard Reference Design? It is difficult to even find many residences that use 30% or 50% less energy that don't also have some form of high efficiency equipment.

Currently the code discourages electric resistance heaters by requiring them to be compared to the more efficient heat pumps. This change would remove the disincentive for electric resistance heating.

Adoptability is a key component of building code enforceability. Codes that are not adopted cannot be enforced. This change will reduce the motivation for cost-effective innovation within the code, and in turn, reduce adoptability.

As energy stringency increases, so should the flexibility of alternate paths, so long as they meet the overall efficiency goal. Flexibility gives consumers a greater choice of products, increases competition among those products, and lowers the prices consumers have to pay for complying products. EC91 works against innovation, adoptability, competition, and energy-efficient design. We urge you to disapprove EC91.

Final Action: AS AM AMPC____ D

EC92-07/08

Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

Revise table as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Glazing[a]	Total area[b] = (a) The proposed glazing area; where the proposed glazing area is less than ~~18%~~15% of the conditioned floor area (b) ~~18%~~15% of the conditioned floor area; where the proposed glazing area is ~~18%~~15% or more of the conditioned floor area	As proposed As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W)	As proposed
	U-Factor: from Table 402.1.2	As proposed
	SHGC: From Table 402.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	Same as standard reference design[c]
	Interior shade fraction: Summer (all hours when cooling is required) = 0.70 Winter (all hours when heating is required) = 0.85	As proposed
	External shading: none	

(Portions of table and footnotes not shown remain unchanged)

Reason: This proposal brings the glazing area percentage in the Standard Reference Design closer to the average window area in homes and, as a result, will save energy for high-fenestration-area homes under the performance path. The current performance path compares the proposed design to a theoretical "standard reference design" home with the same glazing area when less than 18%, but uses 18% glazing area in the standard reference design where the proposed home has a higher glazing area percentage. The performance path is only as accurate as its fundamental assumptions, and based on DOE analysis presented to justify the rewrite of the IECC in 2004, 18% glazing is an artificially high assumption (PNNL concluded for DOE that the average was somewhere between 12% and 17%; this suggests that 15% is a reasonable choice for the performance baseline in the code). A more reasonable assumption of 15% glazing in the performance path will ensure that homes with above-average glazing area percentages meet a stringency level similar to that met by an average house that complies under the prescriptive path.

The performance path is designed so that homes with above-average glazing area must make up the difference elsewhere in the home, either through better windows, insulation, or other efficiency upgrades. The current assumption in the performance path is an 18% average. If that assumption is lowered to 15% (which is more in line with actual data presented by DOE) then homes with above-average (over 15%) glazing using the performance path will have to make up for the loss in efficiency in insulation, windows, or elsewhere in the home.

It is important to note that the proposed amendment to Table 404.5.2(1) does not reduce the actual glazing area of the home or require design changes, but rather, ensures that homes with above-average glazing areas meet the same overall efficiency of the average home built under the prescriptive path. For homes with less than 15% glazing, the standard reference design and proposed design are assumed to have identical glazing area, just as they are in the current performance path. As a result, this change will increase stringency for homes with above average glazing built under the performance path, but will not affect construction under the prescriptive path and/or homes built under the performance path with less than 15% window to wall area.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Approved as Submitted

Committee Reason: The proposal more accurately represents current practice, and is an opportunity for energy savings.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Ron Nickson, National Multi Housing Council, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Glazing	Total area[b]= (a) The proposed glazing area; where the proposed glazing area is less than 15% for single family dwellings and 18% for multifamily dwellings of the conditioned floor area (b) 15% of the conditioned floor area for single family dwellings and 18% of the proposed glazing area for multifamily dwellings; where the proposed glazing area is 15% or more for single family dwellings or 18% or more for multifamily dwellings, the proposed glazing area is 15% for single family dwelling and 18% for multifamily dwellings of the conditioned floor area Orientation: equally distributed to four cardinal compass orientations (N, E, S & W) U-Factor: From Table 402.1.2 SHGC: From Table 402.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used. Interior shade fraction: Summer (all hours when cooling is required) = 0.70 Winter (all hours when heating is required) = 0.85 External shading none	As proposed As proposed As proposed As proposed Same as standard referenced design As proposed

Commenter's Reason: To reinstate the current 18% window provision to cover only multifamily construction. Unlike single family dwellings which have four walls for window placement, multifamily buildings in most cases have only one wall for window placement. Changing the limit to 15% would be extremely restrictive.

Public Comment 2:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The studies referenced in the justification in changing the reference glazing to floor area from 18% to 15% covered primarily single family detached homes. Multifamily and single family attached homes average closer to 20%. This change will unfairly penalize these types of dwellings.

Final Action: AS AM AMPC____ D

EC99-07/08
404.3

Proposed Change as Submitted:

Proponent: Ken Nittler, PE, Enercomp, Inc.

Revise as follows:

404.3 Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report*. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

> **Exception:** ~~Jurisdictions that require site energy (1kWh = 3,413 Btu) rather than energy cost as the metric of comparison.~~ <u>The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.</u>

Reason: If energy cost is going to remain the primary metric for compliance, the purpose of this proposal is to remove the exception for the use of site energy and to allow the use of source energy as an alternative to energy cost.

Adding source energy as an alternative to cost offers many benefits to compliance.

- Using cost will be a liability to the homebuilder if homebuyers do not achieve the savings listed in the compliance documentation.
- It changes frequently. This means that a home that complies today may not comply a few months from now if costs change.
- It focuses attention on first year energy costs, which misses the point of an energy code where features that are generally life cycle cost effective to the homeowner are added to save energy and make homes more comfortable over the life of the home, not to reduce first cost
- The referenced to the *State Energy Price and Expenditure Report* is unclear on which cost figures should be used.

The source multipliers of 3.16 and 1.1 are from the 2002 *DOE Core Databook*. One way to think of this is that electric energy utilized at the site requires 3.16 times the source energy to produce at powerplants and distribute via power lines to homes. This is because the efficiency of power plants is much less than 100% and there are losses in transmission and distribution as well. Other fuels, such as natural gas and fuel oil have less source energy losses and a lower source energy multiplier.

Note that the Las Vegas area, when it adopted the 2003 and 2006 IECC, added a local amendment requiring the use of source energy.

Site energy needs to be deleted because it is wrong anytime there are mixed fuel sources such as gas heating and electric cooling. Site energy only provides a meaningful comparison of energy use in cases where the same energy source is used for heating, cooling and water heating such as an all electric home. But in cases where a home has mixed energy sources, such as gas heating and electric cooling, adding together the site gas use (Btu) plus the air conditioner energy use (kWh * 3413) undervalues the electrical energy used for cooling because of the large generation and transmission losses of electricity compared to natural gas or other fuels. This leads to energy efficiency choices by builders that are flawed. In Phoenix for example, a builder might be encouraged to add a feature like a higher efficiency gas furnace to gain compliance with the IECC when the homeowner would be better served by having a more efficient air conditioner. It is important to note that removing this exception has no impact on the compliance results for cases like an all electric home where using either the cost comparison or the source comparison results in the heating, cooling and water heating energy all being multiplied by the same cost per kWh or the same source multiplier.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: **Approved as Submitted**

Committee Reason: The committee agrees with the proponent that the problem with calculation of site energy costs are that they can change so quickly with time. Source energy use provides a more definitive assessment of the proposed design.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Ted A. Williams, American Gas Association, requests Approval as Submitted.

Commenter's Reason: The exception language proposed permits the use of source energy and source energy multipliers that are consistent with methods used by the U. S. Environmental Protection Agency (EPA) in its Target Finder approach for evaluating building energy consumption over the full fuel cycle and reporting related emissions for ENERGYSTAR rated commercial buildings. It is also consistent with approaches used by the U. S. Energy Information Administration (EIA) for characterizing energy consumption over the full fuel cycle. Use of source energy concepts such as those proposed provide the only means of establishing building carbon footprints associated with energy consumed.

Public Comment 2:

Steven Rosenstock, Edison Electric Institute, requests Disapproval.

Commenter's Reason: This proposal does not save energy, and is technically inaccurate. Source energy can only be estimated, and the values shown as constants are not correct. For example, in areas with a large percentage of renewable energy, the source estimate for electricity is far less than 3.16. Losses associated with imported oil or liquefied natural gas are greater than 10%. Assuming the worst case for electricity and best case for natural gas or fuel oil could lead to one answer, while assuming the best case estimate for electricity and worst case estimate for natural gas and fuel oil could lead to another answer.

Please see http://www.eei.org/industry_issues/energy_infrastructure/fuel_diversity/diversity_map.pdf which shows the regional variations in electric production by fuel type. In addition, in areas with open markets for electric generation, the homeowner can choose how "green" their electric supply is, which also makes source estimates more inaccurate.

In areas with open markets for electric generation, the homeowner can choose how "green" their electric supply is, which also makes source estimates more inaccurate.

The static values shown in EC-99 do not account for the changes in electric generation that will be occurring over the next 5-15 years in well over 50% of the United States.

Also, please see http://www.eei.org/industry_issues/electricity_policy/state_and_local_policies/rpsmap.pdf showing the number of states with renewable portfolio standards. The static values shown in EC-99 do not account for the changes in electric generation that will be occurring over the next 5-15 years in well over 50% of the United States.

Deleting the use of energy cost will not help the home builder or homeowner. Site energy metrics (kWh of electricity, therms of natural gas, gallons of fuel oil) are what homeowners see on their monthly or seasonal bills, along with the costs. Site energy and energy costs provide accurate and meaningful comparisons for home builders, homeowners, and code officials.

In addition, this type of metric could lead to "utility wars" in state codes, which would delay the adoption of more efficient codes and hurt the cause of energy efficiency.

Code officials should not be forced to estimate source energy usage, since there are so many variables and ranges of possibilities. In addition, source energy is not an accurate representation of anything meaningful. It does not address resource scarcity, consumer costs, or pollution impacts. For example:

-Fuel oil used for home heating would be treated as preferable to more plentiful coal, gas, nuclear, or wind used for generating electricity. This is despite the high consumer cost and scarcity issues associated with oil.

-This simplistic source energy estimate makes a BTU of wind exactly equivalent to a BTU of oil, while disregarding the fact that electric utilities are rapidly increasing the percentage of renewable energy used for power generation in many states.

While source energy is very uncertain, the existing option of site energy should be retained. While future energy costs are highly uncertain, site energy provides a straightforward, accurate, and ultimately measurable and verifiable representation of energy use. It is information that will be of the most use to home buyers and should remain as an option in the code.

Bibliography:

Lawrence Berkeley National Labs report on State Renewable Portfolio Standards Program (RPS), April 2008

http://eetd.lbl.gov/ea/ems/reports/lbnl-154e-revised.pdf

Final Action: AS AM AMPC____ D

EC101-07/08

404.4.3

Proposed Change as Submitted:

Proponent: John R. Addario, PE, New York State Department of State Codes Division

Revise as follows:

404.4.3 Additional documentation. The code official shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the standard reference design.
2. A certification signed by the builder providing the building component characteristics of the proposed design as given in Table 404.5.2(1).
3. <u>Documentation of the actual values used in the software calculations for the proposed design.</u>

Reason: The purpose of this proposal is to allow the code official to require documentation that provides the minimum and/or maximum valves allowed by the code, specifically for the proposed design. Some software applications allow values to be entered for the proposed design, which are not allowed when used to calculate compliance. As an example a proposed building might be estimated to have a 0.20 ACH, this value is entered into the software and carried through on all printouts/documentation. The actual software calculations are or should be based on the code minimum of 0.35 ACH. The code official has no way of verifying this unless the documentation is provided. Acceptable documentation can be either in the form of a software printout or contained in the software user manual, this is left up to the software manufacturer.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: **Approved as Submitted**

Committee Reason: It is reasonable to give the code official the authority to ask for documentation of engineering calculations performed.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The printout file that includes the entire building specifications typically amounts to about 12 pages. A cover sheet covers nearly all critical items. Additional information on the detailed printout would include items such as band joist area, stud spacing, each window and orientation etc. Code officials and plan reviewers already have the ability to request this level of detail at their discretion. If this requirement is written into the code, many jurisdictions will automatically require complete building energy details just because it is in the code that will rarely, if ever, be referenced.

This proposal is cumbersome, time consuming and does not contribute to higher levels of energy efficiency. It also creates a time and cost issue for the builder and inspector.

Final Action: AS AM AMPC____ D

EC103-07/08
501.1, 501.2, Chapter 6

Proposed Change as Submitted:

Proponent: Larry Spielvogel, PE, Consulting Engineer, representing himself

1. Revise as follows:

501.1 Scope. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings. These commercial buildings shall meet ~~either the requirements of ASHRAE/IESNA Standard 90.1, *Energy Standard for Buildings Except for Low-Rise Residential Buildings*, or~~ the requirements contained in this chapter.

501.2 Application. The requirements in Sections 502 (Building envelope), 503 (Building mechanical systems), 504 (Service water heating) and 505 (Lighting) shall each be satisfied on an individual basis. ~~Where one or more of these sections is not satisfied, compliance for that section(s) shall be demonstrated in accordance with the applicable provisions of ASHRAE/IESNA 90.1.~~

Exception: Buildings conforming to Section 506, provided Sections 502.4, 502.5, 503.2, 504, 505.2, 505.3, 505.4, 505.6 and 505.7 are each satisfied.

2. Delete without substitution from Chapter 6.

~~**IESNA** Illuminating Engineering Society of North America~~
~~120 Wall Street, 17th Floor~~
~~New York, NY 10005-4001~~

~~90.1-2004 Energy Standard for Buildings Except Low-rise Residential Buildings~~

Reason: This proposal should be adopted to delete optional provisions, simplify the Code, increase stringency, and the following:

1. ASHRAE/IESNA Standard 90.1 is no longer fair and no longer provides minimum criteria for the energy efficient design of buildings. It also no longer provides criteria and requirements that are economically justified and are economically consistent from section to section. Thus, users who follow the requirements of ASHRAE/IESNA Standard 90.1 will be required to install more expensive products and systems for the building envelope that will have much longer paybacks than the products and systems for HVAC, service water heating, and lighting. This is especially unfair and uneconomical in buildings whose heating and cooling requirements are predominantly for ventilation air and internal heat gains, such as schools, health care facilities, and retail establishments.
2. ASHRAE/IESNA Standard 90.1 is less stringent than IECC. With the current provisions in IECC, the requirements in ASHRAE/IESNA Standard 90.1 are often selected to circumvent comparable requirements in IECC and are often less stringent than IECC. Allowing users of the IECC to choose the ASHRAE/IESNA Standard 90.1 option can and will result in less stringent criteria than IECC. For example, the ASHRAE space-by-space method for lighting in Standard 90.1 Section 9.6 is less stringent than comparable requirements in IECC in virtually every type of occupancy. In addition, there are additional lighting power allowances in Section 9.6.2 of Standard 90.1 that do not exist in IECC, such as those for retail occupancies and that can more than double the amount of lighting compared with what is allowed in IECC. Every section of Standard 90.1 has many more options and exceptions than IECC, almost all of which are less stringent than IECC.
3. The building envelope portion of this current proposal was already approved by the IECC committee in EC82-06/07, to remove the option to use the envelope provisions of Standard 90.1 in lieu of complying with IECC Section 502. The proposal was withdrawn by the proponent for other reasons in the final hearings.
4. ASHRAE has not honored its commitment to publish updated versions of the Standard every 3 years by the deadline for submission to the IECC. Therefore, there is no certainty that a current version of the Standard will be available for this Code Cycle, or any future cycle. As of the deadline for this proposal, the 2007 version of ASHRAE/IESNA Standard 90.1 has not been published or approved by ANSI.
5. If ASHRAE does eventually publish a 2007 edition, and proposes to replace the currently referenced 2004 edition, it may not be an ANSI approved consensus standard, in violation of ICC requirements.
6. By not adopting this proposal, continuing to allow or require users of the IECC to use outdated sections of versions of the ASHRAE Standard is not consistent with the requirements or stringency of the IECC.
7. In June 2007, the ASHRAE Board of Directors passed a motion requiring and directing that: "Unregulated loads will be added to Standard 90.1, perhaps establishing a recommended level of *March 28, 2007* W/ft2." Thus, users of the IECC who elect the option to use Standard 90.1 will be required to comply with criteria that cannot be regulated by building officials at the time of design, construction, and occupancy, by ASHRAE's own admission.
8. The ASHRAE Board of Directors passed another motion directing the Standard 90.1 Committee to increase stringency without regard to following the technical and economic criteria used to date. Therefore, there is no assurance that future editions of the ASHRAE Standard will be consistent with the technical and economic criteria in IECC.
9. The resulting Standard 90.1 approved Work Plan requires: "That Standard 90.1-2010 is developed with the goal of achieving a 30% energy savings improvement compared to Standard 90.1-2004, per the direction of the ASHRAE Board of Directors motion." Thus, it is almost a certainty that ASHRAE/IESNA Standard 90.1 will no longer be a minimum set of criteria and requirements for the economical design and construction of energy efficient buildings.
10. The ASHRAE committee is no longer balanced. ASHRAE persists in not appointing, reappointing, and rejecting applications from prospective voting committee members who may not agree with the majority opinions or directions from ASHRAE management, such as prospective members who apply who are materially affected and interested persons. This includes builders, contractors, and members from associations representing building owners, such as the National Multi-Housing Council, National Association of Home Builders, and the National Apartment Association, despite those persons having the necessary technical qualifications.
11. HR 3221, passed by the U.S. House of Representatives on August 4, 2007, includes provisions that if ASHRAE 90.1 does not achieve a 30% reduction by 2010, and 50% reduction by 2020 (regardless of whether those reductions are technically or economically feasible), Section 304 of the bill requires the Secretary of Energy to "propose a modified code or standard that meets such targets." Then, each state shall "certify that it has achieved compliance with the certified building energy code." Such a government code or standard could supersede and preempt comparable private sector documents. This could render the IECC moot.
12. Finally, in Section 6, the reference to ASHRAE/IESNA Standard 90.1-2001 is no longer current or up-to-date and is not supported.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Disapproved

Committee Reason: The standard ASHRAE 90.1 has long been an accepted standard for energy conservation. The IECC Committee feels that, given that the values and the practices established in the IECC are fundamentally similar to those of ASHRAE 90.1, that we should continue to offer the option of using ASHRAE 90.1.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Ken Sagan, National Association of Home Builders, requests Approval as Submitted.

Commenter's Reason: IECC is its own stand-alone energy code complete with prescriptive and performance compliance paths. A wholesale reference to ASHRAE 90.1 does not add value to the document. If a state or local jurisdiction desires to have ASHRAE 90.1 as their alternative code, they are free to do this. In addition, ASHRAE has been trying to impose its overly complex standard directly into the body of the commercial portion of the IECC with 5 code proposals coming directly from ASHRAE and at least a dozen more referencing ASHRAE 90.1 as the source for the numbers or justification for the change.

Final Action: AS AM AMPC____ D

EC104-07/08
501.1, 501.2, 502.1.1, Table 502.2(2), Chapter 6

Proposed Change as Submitted:

Proponent: Ron Nickson, National Multi Housing Council (NMHC)

1. Revise as follows:

501.1 Scope. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings. ~~These commercial buildings shall meet either the requirements of ASHRAE/IESNA Standard 90.1, *Energy Standard for Buildings Except for Low-Rise Residential Buildings,* or the requirements contained in this chapter.~~

501.2. Application. The requirements in Section 502 (Building envelope), 503 (Building mechanical systems), 504 (Service water heating) and 505 (Lighting) shall each be satisfied on an individual basis. ~~Where one or more of these sections is not satisfied, compliance for that section(s) shall be demonstrated in accordance with the applicable provisions of ASHRAE/IESNA 90.1.~~

> **Exception:** Buildings conforming to Section 506, provided Sections 502.4, 502.5, 503.2, 504, 505.2, 505.3, 505.4, 505.6 and 505.7 are each satisfied.

502.1.1 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Tables 502.2(1) and 502.3 based on the climate zone specified in Chapter 3. ~~Buildings with a vertical fenestration area or skylight area that exceeds that allowed in Table 502.3 shall comply with the building envelope provisions of ASHRAE/IESNA 90.1.~~

Table 502.2(2)
METAL BUILDING ASSEMBLY DESCRIPTION

ROOFS	DESCRIPTION	REFERENCE
R-19 + R-10	Filled cavity roof. Thermal blocks are a minimum, R-5 of rigid insulation, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin. This construction is R-10 insulation batts draped perpendicularly over the pulins, with enough looseness to allow R-19 batt to be laid above it, parallel to the pulins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins. In the metal building industry, this is known as the “sag and bag” insulation system.	~~ASHRAE/IESNA 90.1 Table A2.3~~
R-19	Standing seam with single insulation layer. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin. This construction R-19 insulation batts draped perpendicular over the pulins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	~~ASHRAE/IESNA 90.1 Table A2.3~~
Walls		
R-13	Single insulation layer The first layer of R-13 insulation batts is installed continuously perpendicular to the girts and is compressed as the metal skin is attached to the girts and is compressed as the metal skin is attached to the girts.	~~ASHRAE/IESNA 90.1 Table A2.3~~
R-13 + R-13	Double insulation layer The first layer of R-13 insulation batts is installed continuously perpendicular to the girts, and is compressed as the metal skin is attached to the girts. The second layer of R-13 insulation batts is installed within the framing cavity.	~~ASHRAE/IESNA 90.1 Table A2.3~~

For SI: 1 inch = 25.4 mm.

2. Delete without substitution from Chapter 6:

ASHRAE

~~90.1-2004 Energy Standard for Buildings Except Low-rise Residential Buildings (ANSI/ASHRAE/IESAN 90.1-2004)~~

~~**IESNA**~~

~~90.1-2001 Energy Standard for Buildings Except Low-rise Residential Buildings~~

Reason: The change is submitted to remove the reference to ASHRAE/IESNA 90.1 Energy Standard for Buildings Except Low-rise Residential Buildings. The IECC is a stand alone document setting minimum requirements for energy conservation in all type of buildings and the reference to ASHRAE/IESNA is not needed. The reference to ASHRAE/IESNA 90.1 is also in appropriate in that the standard is no longer a minimum standard,, but rather a standard with a directed purpose to increase energy stringency based on specific goals directed by the ASHRAE leadership.

Cost Impact: This code change proposal will not increase the cost of construction.

Committee Action: **Disapproved**

Committee Reason: See committee reason for disapproval of EC103-07/08.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Ken Sagan, National Association of Home Builders, requests Approval as Submitted.

Commenter's Reason: IECC is its own stand-alone energy code complete with prescriptive and performance compliance paths. A wholesale reference to ASHRAE 90.1 does not add value to the document. If a state or local jurisdiction desires to have ASHRAE 90.1 as their alternative code, they are free to do this. In addition, ASHRAE has been trying to impose its overly complex standard directly into the body of the commercial portion of the IECC with 5 code proposals coming directly from ASHRAE and at least a dozen more referencing ASHRAE 90.1 as the source for the numbers or justification for the change.

Final Action: AS AM AMPC____ D

EC105-07/08
501.2

Proposed Change as Submitted:

Proponent: Chuck Murray, Washington State University Extension Energy Program, representing Northwest Energy Code Group

Revise as follows:

501.2 Application. ~~The requirements in Sections 502 (Building envelope), 503 (Building mechanical systems), 504 (Service water heating) and 505 (Lighting) shall each be satisfied on an individual basis. Where one or more of these sections is not satisfied, compliance for that section(s) shall be demonstrated in accordance with the applicable provisions of ASHRAE/IESNA 90.1.~~ The commercial building project shall comply with the requirements in Sections 502 (Building envelope), 503 (Building mechanical systems), 504 (Service water heating) and 505 (Lighting) in its entirety. As an alternative the commercial building project shall comply with the requirements of ASHRAE/IESNA 90.1 in its entirety.

Exception: Buildings conforming to Section 506, provided Sections 502.4, 502.5, 503.2, 504, 505.2, 505.3, 505.4, 505.6 and 505.7 are each satisfied.

Reason: This proposal directs the permit applicant to apply either the IECC or ASHRAE/IESNA Standard 90.1 (90.1), not a mix of both. As written a mix of both codes is allowed on a single permit application. As written code review may require the use of two different energy code books to determine compliance. This proposal simplifies the process by limiting the applicant to a single energy code book.

Both the IECC and 90.1 were written to provide minimum energy code compliance without taking into account the base requirements, code compliance options and exceptions expressed in the other code. As a result, mixing and matching code sections may not result in a structure that achieves the energy efficiency targets of either code when applied individually.

Section 501.1 allows the code user to user to mix compliance approaches using either the provisions within 90.1 or IECC Chapter 5. As written, energy code compliance can be demonstrated using Chapter 5 for envelope compliance, 90.1 for the mechanical system and Chapter 5 for the lighting system. Typically the compliance approach that is used is selected because it offers the least restrictive method of compliance. For example, designers typically use 90.1 to demonstrate compliance with the energy code to eliminate the need to install a vestibule as required by Section 502.4.6. because 90.1 exempts buildings less that 4 stories from installing a vestibule.

The ability to "game" the system results in confusion from the jurisdictions in trying to enforce the energy code as they try to determine which compliance method each of energy using system must comply with. Also, 90.1 and Chapter 5 are designed to be used in its entirety to achieve the maximum energy savings. This code change proposal requires the energy code user to comply with either Chapter 5 in its entirety or 90.1 in its entirety and not allow the code user to select the least stringent compliance approach.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Approved as Submitted

Committee Reason: It is inadvisable to continue the current practice allowed in our code of mixing and matching provisions of ASHRAE with IECC. This could ultimately result in a building that does not meet the basic goals of either code.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Katherine C. Abernathy LC, IALD, Abernathy Lighting Design, Inc. representing the International Association of Lighting Designers, requests Disapproval.

Commenter's Reason: This proposed change removes important flexibility for designers in complying with code and standards. It is clear that for many projects it is impossible to figure out how to comply with the IECC since there are no provisions for the building/space type in the LPD tables, we strongly feel that ASHRAE/IESNA 90.1 should remain as an alternative path for lighting projects that are not covered by IECC.

Public Comment 2:

James R. Benya, PE, FIESNA, FIALD, LC, Benya Lighting Design, representing himself, requests Disapproval.

Commenter's Reason: The original intent of the IECC was to provide a simplified alternative to 90.1. However, the lighting sections of IECC are too simplified for complex buildings and it is necessary to provide the designer with the option of either.

The proponent argues that his change is needed to prevent gaming. Gaming does not occur when a code is met as written. The original technical intent of IECC and 90.1 is to provide the same allowance under the same conditions. Coupled with the proponent's other proposals, it appears that the proponent intends to cause IECC to become more stringent than 90.1 and to force most designers to observe this greater stringency. Therefore, this proposal should be rejected as it makes a significant change not consistent with the intent of the IECC.

Bibliography
California Energy Commission CEC-400-2008-011

Public Comment 3:

Ron Burton, BOMA International, requests Disapproval.

Commenter's Reason: Code change proposal EC105-07/08 dealing with IECC Section 501.2 contains inappropriate terminology ("commercial building project") which is not defined in the IECC, has no industry standard definition, and was not eliminated or modified during the Public Hearings in Palm Springs, CA. This inappropriate terminology will result in confusion and will be subject to the individual interpretation of the inspector in the field or other representatives of the jurisdiction having authority. It will therefore be necessary for the jurisdiction having authority to modify this section if adoption of the 2009 edition of the IECC is considered.

More importantly, the language in the current Section 501.2 referencing ASHRAE/IESNA Standard 90.1 would be changed if code change EC105-07/08 is approved so that where one or more of the requirements in Section 502, 503, 504, or 505 are not satisfied on an individual basis, the user would be required to comply with the requirements of ASHRAE/IESNA Standard 90.1 for ALL elements of building envelope, mechanical systems, service water heating, and lighting. This is in contravention of the current language which allows compliance with IECC provisions EXCEPT for those areas where compliance with the IECC cannot be satisfied. Provisions contained in ASHRAE/IESNA Standard 90.1 dealing with the elements covered in IECC Sections 502, 503, 504, and 505 are not strictly equivalent to the IECC and may not cover all elements currently covered in Section 501.2.

BOMA International therefore recommends Disapproval of code change proposal EC105-07/08.

Public Comment 4:

Jason Groob, Horton Lees Brogden Lighting Design, requests Disapproval.

Commenter's Reason: Because of the vast differences in the various code sections, the design team should have the ability to choose which code and compliance method are most appropriate for the applicable project. Both ICC Chapter 5 and 90.1 are intended to provide efficient building design provisions, and therefore each code section should be viable to stand on its own as an energy savings measure, regardless of the code to which other systems apply. This proposed change would remove some of the important flexibility of the design team in complying with the codes and standards.

Public Comment 5:

Glenn Heinmiller IALD, LC, LEED AP, Lam Partners, Inc., representing himself, requests Disapproval.

Commenter's Reason: Forcing the lighting designer to use IECC because the other disciplines are using IECC could lead to poorer energy performance for some project types. The building/space types available in IECC are limited and do not cover as many building and space types as 90.1. If lighting designers are forced to use IECC on projects where building/space types in the project are not listed, they will have to pick something which will likely be a type with a high power density, leading to higher energy usage than if 90.1 were used, or worst case they will ignore the code altogether because it is impossible to figure out how to comply. Professional lighting designers need a workable standard to design to, so until IECC becomes as comprehensive as 90.1, 90.1 should remain as an alternative path for lighting for projects that are not covered by IECC.

Public Comment 6:

Hyman Kaplan, Hy-Lite Design, Inc., representing himself, requests Disapproval.

Commenter's Reason: The IECC contains only one set of lighting power densities and ASHRAE/IES 90 has two, including room-by-room. Other members of the design team may wish to use IECC when lighting needs to use room-by-room method. Most building departments review sections separately.

Final Action: AS AM AMPC____ D

EC106-07/08

502.1.1, 502.1.2, Table 502.2(1), Table 502.1.2

Proposed Change as Submitted:

Proponent: John Neff, Washington State Building Code Council

Revise as follows:

502.1.1 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Tables 502.2(1) and 502.3 based on the climate zone specified in Chapter 3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the R-values from the "Group R" column of Table 502.2(1). Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the R-values from the "All other" column of Table 502.2(1). Buildings with a vertical fenestration area or skylight area that exceeds that allowed in Table 502.3 shall comply with the building envelope provisions of ASHRAE/IESNA 90.1.

502.1.2 (Supp) U-factor alternative. An assembly with a U-factor, C-factor, or F-factor equal or less than that specified in Table 502.1.2 shall be permitted as an alternative to the R-value in Table 502.2 (1). Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the U-factor, C-factor, or F-factor from the "Group R" column of Table 502.1.2. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the U-factor, C-factor, or F-factor from the "All other" column of Table 502.1.2.

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

	1		2		3		4 except Marine		5 and marine 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above deck	R-15ci	R-20ci	~~R-15ci~~ R-20ci	R-20ci	R-~~15ci~~ R-20ci	R-20ci	~~R-15ci~~ R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks[a])[b]	R-19 + R-10	R-19 + R-10	R-19	R-19	R-19	R-19	R-19	R-19	R-19	R-19	R-19	R-19	R-19 + R-10	R-19 + R-10	R-19 + R-10	R-19 + R-10
Attic and other	R-30	R-38	R-~~30~~ 38	R-38	R-~~30~~ 38	R-38	R-~~30~~ 38	R-38	R-~~30~~ 38	R-38	R-~~30~~ 38	R-38	R-38	R-38	R-~~38~~ 49	R-49
Walls, Above Grade																
Mass	NR	R-5.7ci	~~NR~~ R-5.7ci	~~NR~~ R-7.6ci	~~R-5.7ci[c, e]~~ R-7.6ci	R-9.5ci	R-~~5.7ci~~ R-9.5ci[c]	R-11.4ci	~~R-7.6ci~~ R-11.4ci	R-13.3 ci	~~R-9.5ci~~ R-13.3ci	R-15.2ci	~~R-11.4ci~~ R-15.2ci	R-15.2ci	~~R-13.3~~ R-25ci	R-25ci
Metal building[b]	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13
Metal framed	R-13	R-13	R-13	R-13+7.5ci	R-13 + R3.8ci	R-13 + R7.5ci	R-13 +7.5	R-13 + R7.5ci	R-13 + R-~~3.8~~ 7.5 ci	R-13 + R7.5ci	R-13 + R-~~3.8~~ 7.5ci	R-13 + R7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5 ci	R-13 + R-18.8ci
Wood framed and other	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13+ R-3.8ci	R-13 + R-3.8ci	R-13 +3.8	R-13 + 7.5	R-13 + R-7.5	R-13+ R-7.5ci	R-13 +7.5ci	R-13 + R-~~7.5~~ 15.6ci	R-13 +15.6ci
Walls, Below Grade																
Below grade wall[d]	NR	NR	NR	NR	NR	NR	NR	R-7.5ci	~~NR~~ R-7.5ci	R-7.5ci	NR R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-12.5ci
Floors																
Mass	NR	NR	~~R-5ci~~ R-6.3ci	R-8.3ci	R-~~5ci~~ R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	~~R-10ci~~ R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/Framing Steel/(Wood)	NR	NR	R-19	R-30	R-19	R-30	R-~~19~~ R-30	R-30	~~R-19~~ R-30	R-30	R-30	R-30[e]	R-30	R-30[e]	R-30[e]	R-30[e]
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	~~NR~~ R-10 for 24 in. below	R-15 for 24 in. below	~~NR~~ R-15 for 24 in. below	R-15 for 24 in. below	R-~~10~~ 15 for 24 in. below	R-20 for 24 in. below
Heated slabs	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-~~7.5~~ 10 for ~~12~~ 24 in. below	10 24 in. below	R-~~7.5~~ 15 for ~~12~~ 24 in. below	R-15 for 24 in. below	R-~~10~~ 15 for 24 in. below	R-15 for 24 in. below	R-~~10~~ 15 for ~~36~~ 24 in. below	R-20 for 48 in. below	R-~~10~~ 20 for ~~36~~ 24in. below	R-20 for 48 in. below	R-~~10~~ 20 for 48 in. below	R-20 for 48 in. below
Opaque Doors																
Swinging	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.50	U – ~~0.70~~ 0.50	U – 0.50	U – 0.50	U – 0.50
Roll-up or sliding	U – 1.45	U – 1.45	U – 1.45	U – 1.45	U – 1.45	U – 1.45	U – ~~1.45~~ .50	U – 0.50	U – ~~1.45~~ 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50

For SI: 1 inch = 25.4 mm.
ci – Continuous Insulation NR – No Requirement

a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.
b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci may be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 in. or less on center vertically and 48 in. or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-f ^{2} F.

d. When heated slabs are placed below grade, below grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

~~e. Insulation is not required for mass walls in Climate Zone 3A located below the “Warm-Humid” line, and in Zone 3B.~~ Steel floor joist systems shall be R-38

TABLE 502.1.2 (Supp)
BUILDING ENVELOPE REQUIREMENTS OPAQUE ELEMENT, MAXIMUM U-FACTORS

	1		2		3		4 except Marine		5 and Marine 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above deck	U-0.063	~~U-0.063~~ U-0.048	~~U-0.063~~ U-0.048	U-0.048	~~U-0.063~~ U-0.048	U-0.048	~~U-0.063~~ U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039
Metal buildings ~~(with R-5 thermal blocksa)b~~	U-0.052	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.052	U-0.052
Attic and other	U-0.034	U-0.027	~~U-0.034~~ U-.0270	U-.0270	~~U-0.034~~ U-.0270	U-0.027	~~U-0.034~~ U-.0270	U-0.027	~~U-0.034~~ U-.0270	U-0.027	~~U-0.034~~ U-.0270	U-0.027	~~U-0.034~~ U-.0270	U-0.027	U-.0270	U-.0270
Walls, Above Grade																
Mass	U-0.058	U-0.151	~~U-0.058~~ U-0.151	U-0.123	~~U-0.151~~ U-0.123	U-0.104	~~U-0.151~~ U-0.104	U-0.090	~~U-0.123~~ U-0.90	U-0.80	~~U-0.104~~ U-0.080	U-0.071	~~U-0.090~~ U-0.071	U-0.071	~~U-0.080~~ U-0.071	U-0.052
Metal building~~b~~	U-0.113	U-0.113	U-0.113	U-0.113	U-0.113	U-0.113	U-0.113	U-0.113	U-0.113	U-0.057	U-0.057	U-0.057	U-0.057	U-0.057	U-0.057	U-0.057
Metal framed	U-0.124	U-0.124	U-0.124	U-0.064	~~U-0.124~~ U-0.084	U-0.064	~~U-0.124~~ U-0.064	U-0.064	~~U-0.084~~ U-0.064	U-0.064	~~U-0.084~~ U-0.064	U-0.057	U-0.064	U-.052	U-0.064	U-0.037
Wood framed and other	U-0.089	U-0.089	U-0.089	U-0.089	U-0.089	U-0.089	U-0.089	U-0.064	~~U-0.089~~ U-0.064	U-0.051	~~U-0.089~~ U-0.051	U-0.051	~~U-0.089~~ U-0.051	U-0.051	~~U-0.051~~ U-0.036	U-0.036
Walls, Below Grade																
Below grade wall[a]	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-0.119	~~C-1.140~~ C-0.119	C-0.119	~~C-1.140~~ C-0.119	C-0.119	~~C-1.140~~ C-0.119	C-0.092	C-0.119	C-0.075
Floors																
Mass	U-0.322	U-0.322	~~U-0.123~~ U-0.107	U-0.087	~~U-0.123~~ U-0.107	U-0.087	~~U-0.076~~ U-0.087	U-0.074	~~U-0.076~~ U-0.074	U-0.064	~~U-0.076~~ U-.064	U-.057	~~U-0.055~~ U-0.064	U-0.051	~~U-0.076~~ U-0.057	U-0.051
Joist/Framing	~~U-0.350~~ U-0.282	U-0.282	U-.052	U-.052	~~U-.052~~ ~~U-.051~~	U-.033	~~U-.052~~ U-.033	U-.033	~~U-.052~~ U-.033	U-.033	~~U-.038~~ U-.033	U-.033	~~U-.052~~ U-.033	U-.033	~~U-.052~~ U-.033	U-.033
Slab-on-Grade Floors																
Unheated slabs	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	F-0.540	F-0.730	F-0.540	~~F-0.730~~ F-0.540	F-0.520	~~F-0.730~~ F-0.52	F-0.52	~~F-0.540~~ F-0.520	F-0.510
Heated slabs	F-1.020	F-1.020	F-1.020	F1.020	~~F-1.020~~ F-0.900	F-0.900	~~F-1.020~~	F-0.860	~~F-0.950~~ F-0.860	F-0.860	~~F-0.840~~ F-0.860	F-0.688	~~F-0.840~~ F-0.830	F-0.688	~~F-0.780~~ F-0.688	F-0.688

a. When heated slabs are placed below grade, below grade walls must meet the F-factor requirements for perimeter insulation according to the heated slab-on-grade construction.

Reason: The purpose of this proposal is to introduce specific building envelope criteria for commercial buildings that include Group R occupancies. This proposal has uses the R-values, U-factors, C-factors and F-factors from ANSI/ASHRAE/IESNA Standard 90.1-2004 addenda as[1], except when the existing values in this code are more stringent.

Loads for residential buildings have different space conditioning loads than commercial structures. For many years the analysis of loads conducted by the ANSI/ASHRAE/IESNA Standard 90.1 building envelope committee has resulted in the adoption of a separate set of criteria for commercial buildings that include group R occupancies, than for other commercial occupancies.

Because ANSI/ASHRAE/IESNA Standard 90.1 is an alternate standard to this code, it is prudent to include consistent application of building envelope standards between these two codes. The adoption of addenda as provides consistency between these two codes.

Bibliography

[1]BSR/ASHRAE Addenda as and at to ANSI/ASHRAE Standard 90.1-2004
http://www.ashrae.org/technology/page/132

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: Approved as Submitted

Committee Reason: This change picks up values for residential that agree with ASHRAE 90.1, and also represents savings in energy in both residential and commercial. The committee notes that the residential portion of the table would apply to all residential outside of the definition of residential in the IECC (i.e. residential greater than 3 stories.), which are covered by Chapter 5.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

James D. Bowman, American Forest & Paper Association, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

	1		2		3		4 except Marine		5 and marine 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Walls, Above Grade																
Wood framed and other	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13+ R-3.8ci or R-19	R-13 + R-3.8ci or R-19	R-13 +3.8ci or R-19	R-13 + 7.5ci or R-19	R-13 + R-7.5ci or R-19	R-13+ R-7.5ci or R-19	R-13 +7.5ci or R-19	R-13 + 15.6ci or R-30	R-13 +15.6ci or R-30

(Portions of proposal not shown remain unchanged)

Commenter's Reason: Minimum insulation requirements should not be limited only to batt plus continuous insulation combinations. This change too narrowly limits the prescriptive product scope to insulation board, failing to recognize equivalent batt solutions Options should also include a simple R-value requirement -- which would be more inclusive of other products. An energy code should not be in the business of limiting markets to the board insulation industry and should define language that is sufficiently broad to allow the use of batt-only options by those who want that flexibility. In R-value only option should be added to maintain prescriptive flexibility when it has no adverse impact on efficiency, as is the case with this proposed modification.

There are also inequities between steel and wood wall assemblies. In Zone 8, wood walls (All Other) are required to have R-13 batts + 15.6 continuous insulation when steel walls only need R-13 batts + 7.5 continuous insulation. The tables have inconsistently included references to "ci", which designates continuous insulation. In some cases, note that only options are allowed which limits flexibility and options to use different insulation materials.

Performance calculations should not be required to justify the batt only option when the R-values can simply be added to the tables and achieve an easier compliance solution. This creates avoidable project expense.

Public Comment 2:

Casey Harkins, Thermal Design, Inc., representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

Climate Zone	1		2		3		4 except Marine		5 and Marine 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Metal buildings (with R-5 thermal blocks[a])[b]	~~R-19 + R-10~~ R-11 + R-19 ls	~~R-19 + R-10~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-19 ls	~~R-19~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-19 ls	~~R-19~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-30 ls	~~R-19~~ R-11 + R-30 ls	~~R-19 + R-10~~ R-11 + R-30 ls	~~R-19 + R-10~~ R-11 + R-30 ls	~~R-19 + R-10~~ R-11 + R-11 + R-25 ls	~~R-19 + R-10~~ R-11 + R-11 + R-25 ls

For SI: 1 inch = 25.4 mm.
ci – Continuous Insulation
ls – Liner System
NR – No Requirement

TABLE 502.2(2)
METAL BUILDING ASSEMBLY DESCRIPTIONS

ROOFS	DESCRIPTION	REFERENCE
~~R-19 + R-10~~	~~Filled cavity roof.~~ ~~Thermal blocks are a minimum, R-5 of rigid insulation, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin.~~ ~~This construction is R-10 insulation batts draped perpendicularly over the purlins, with enough looseness to allow R-19 batt to be laid above it, parallel to the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins. In the metal building industry, this is known as the "sag and bag" insulation system.~~	~~ASHRAE/IESNA 90.1 Table A2.3~~
~~R-19~~	~~Standing seam with single insulation layer.~~ ~~Thermal blocks are a minimum, R-5 of rigid insulation, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin.~~ ~~This construction R-19 insulation batts draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.~~	~~ASHRAE/IESNA 90.1 Table A2.3~~
R-11 + R-19 ls	Liner system. A continuous vapor barrier liner is installed below the purlins and uninterrupted by framing members. One layer of uncompressed, unfaced R-19 insulation rests on top of the liner between the purlins. A second layer of unfaced R-11 insulation is draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1-2007 Addendum g
R-11 + R-25 ls	Liner system. A continuous vapor barrier liner is installed below the purlins and uninterrupted by framing members. One layer of uncompressed, unfaced R-25 insulation rests on top of the liner between the purlins. A second layer of unfaced R-11 insulation is draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1-2007 Addendum g
R-11 + R-30 ls	Liner system. A continuous vapor barrier liner is installed below the purlins and uninterrupted by framing members. One layer of uncompressed, unfaced R-30 insulation rests on top of the liner between the purlins. A second layer of unfaced R-11 insulation is draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1-2007 Addendum g
R-11 + R-11 + R-25 ls	Liner system. A continuous vapor barrier liner is installed below the purlins and uninterrupted by framing members. One layer of uncompressed, unfaced R-11 insulation and one layer of uncompressed, unfaced R-25 insulation rests on top of the liner between the purlins. A third layer of unfaced R-11 insulation is draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1-2007 Addendum g

TABLE 502.1.2
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ELEMENT, MAXIMUM U-FACTORS

Climate Zone	1		2		3		4 except Marine		5 and Marine 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Metal buildings	~~U-0.052~~ U-0.035	~~U-0.065~~ U-0.031	~~U-0.065~~ U-0.035	~~U-0.065~~ U-0.031	~~U-0.065~~ U-0.035	~~U-0.065~~ U-0.031	~~U-0.065~~ U-0.031	~~U-0.065~~ U-0.031	~~U-0.065~~ U-0.031	~~U-0.065~~ U-0.031	~~U-0.065~~U-0.029	~~U-0.065~~ U-0.029	~~U-0.065~~ U-0.029	~~U-0.065~~ U-0.029	~~U-0.052~~ U-0.026	~~U-0.052~~ U-0.026

(Portions of proposal not shown remain unchanged)

Commenter's Reason: The current metal building roof requirements, as well as the new Group-R requirements in EC106-07/08 are based on thermal modeling of assemblies which cannot be achieved with current construction practices. These assemblies are likely performing at least 20% below the intended level in actual constructions. In addition, EC106-07/08 has consistency problems between the R-Value requirements and U-Factor requirements for the Group-R columns in Table 502.1.2 for climate zones 1 and 7. This comment proposes replacing these erroneous assemblies with new requirements based on the economic optimization spreadsheet and parameters that will be utilized by ASHRAE in development of the forthcoming 90.1-2010 Standard.

Public Comment 3:

Jonathan Humble, AIA, American Iron and Steel Institute, representing AISI and the Steel Framing Alliance, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

Climate Zone	1		2		3	
	All other	Group R	All other	Group R	All Other	Group R
Walls Above Grade						
Metal Framed	R-13	R-13	R-13	~~R-13+3.8 ci~~ **R-13**	~~R-13+3.8ci~~ **R-13**	~~R-13 +7.5ci~~ **R-13**
Wood Framed	R-13	R-13	R-13	R-13	R-13	R-13

(Portions of proposal not shown remain unchanged)

Commenter's Reason: We would like to applaud the efforts by the proponents for developing this proposal to recognize Group R occupancies in Chapter 5, and to encourage greater energy efficiency. It is the steel industries recommendation to request that EC106-07/08 be further modified as shown above.

Simulations were made using Energy Gauge v3.11. The building simulated was a typical 32 unit, four-story, multi-family building which was located in multiple cities within Climate Zones 1, 2 and 3. The results illustrated that there is little difference in the annual energy cost of a building using either metal or wood framing that contains R-13 insulation in the wall cavity when comparing the simulated building in multiple city locations within the same climate zone. These results suggest that the performance difference is negligible. We further found that the additional cost to add continuous insulation to the opaque portions of building envelope walls containing metal framing is not cost justified in these climate zones. The simple-pay-back comparison revealed a 45 year plus payback period. As a result, we found it difficult to justify supporting EC106-07/08 in total.

In view of these findings, we propose that the tabular values in the category “metal walls” for “Climate Zones #2 and #3” be modified as shown in this code challenge.

Bibliography:
1] ASHRAE, “Energy Standard for Buildings Except Low-Rise Residential Buildings”, American Society of Heating, Refrigerating, and Air-conditioning Engineers, Atlanta, GA, 2004 and 2007 editions.

2] Reed Construction Data, “RS Means Square Foot Costs”, Reed Construction Data, Kingston, MA, 2006.

A copy of the building modeling file can be provided upon request by contacting Newport Ventures at Mmoore@newportpartnersllc.com.

Public Comment 4:

Ron Burton, BOMA, International, requests Disapproval.

Commenter's Reason: The ***Report of the Public Hearings*** listing of the actions during the Public Hearings is in error as it lists NO Assembly Action. However, there was Assembly Action on EC106-07/08 that narrowly failed to recommend Disapproval of this code change. BOMA International therefore is filing this comment to ensure that EC106-07/08 will be on the agenda for Final Action Consideration.

In addition, BOMA International believes code change EC106-07/08 should be Disapproved because the increase in the cost of construction confirmed by the proponent in its Reason statement was not quantified. There were either no cost impacts computed by the proponent, or the proponent did not reveal these figures during the Public Hearing debates, therefore depriving the Committee of essential information necessary to render a decision. It is therefore impossible to assess the economic impacts on the construction industry, building owners, potential tenants, the local and/or regional economy, the tax base in the jurisdiction having authority, or any other criteria that should be reasonably expected by the Committee, those in attendance during the Public Hearing, or the voting members of ICC. BOMA International therefore recommends Disapproval by the voting members of ICC during the Final Action Consideration.

Final Action: AS AM AMPC____ D

EC108-07/08

502.1.3 (New), 502.1.3.1 (New), 502.1.3.2 (New), Table 502.1.2

Proposed Change as Submitted:

Proponent: Julie Ruth, JRuth Code Consulting, representing the American Architectural Manufacturers Association (AAMA)

1. Add new text as follows:

502.1.3 Total UA and total SHGCA alternative.

502.1.3.1 Total UA. If the total proposed building thermal envelope UA (sum of the U-factor or C-factor times each assembly area, plus the F-factor times the perimeter length for slab-on-grade floors) is less than or equal to the total standard building UA resulting from using the opaque assembly U-factors, C-factors and F-factors in Table 502.1.2, opaque door U-factors in Table 502.2(1), and fenestration U-factors in Table 502.3 the building shall be considered in compliance with Tables 502.2(1) and 502.3. Assembly U-factor calculations shall be done using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials.

For this calculation the standard building assembly areas shall be determined in accordance with the following:

1. If the proposed building vertical fenestration area does not exceed the maximum vertical fenestration area allowed in Table 502.3 and the skylight area does not exceed the maximum skylight area in Table 502.3, the standard assembly areas shall be the same as the proposed building assembly areas.
2. If the proposed building vertical fenestration exceeds the maximum vertical fenestration area allowed in Table 502.3, then the standard building shall use the maximum vertical fenestration area allowed in Table 502.3 and the opaque above grade wall assembly area shall be increased so that the gross above grade wall area (vertical fenestration area plus opaque door area) is the same as the proposed building.
3. If the proposed building skylight area exceeds the maximum skylight area allowed in Table 502.3, then the standard building shall use the maximum skylight area allowed in Table 502.3 and the opaque roof assembly area shall be increased so that the gross roof area (skylight area plus opaque roof area) is the same as the proposed building.)

502.1.3.2 Total SHGCA. If the total proposed building fenestration (vertical fenestration plus skylight) SHGCA (sum of SHGC times fenestration area for each fenestration type) is less than or equal to the total standard building SHGCA resulting from using the fenestration SHGC in Table 502.3, the building shall be considered in compliance with Tables 502.2(1) and 502.3.

For this calculation, the standard building fenestration areas shall be determined in accordance with the following:

1. If the proposed building vertical fenestration area does not exceed the maximum vertical fenestration area allowed in Table 502.3 and the skylight area does not exceed the maximum skylight area in Table 502.3, the standard assembly areas shall be the same as the proposed building assembly areas.
2. If the proposed vertical fenestration area exceeds the maximum vertical fenestration area allowed in Table 502.3, then the standard building shall use the maximum vertical fenestration area allowed in Table 502.3.
3. If the proposed building skylight area exceeds the maximum skylight area allowed in Table 502.3, then the standard building shall use the maximum skylight area allowed in Table 502.3.

2. Revise table title as follows:

TABLE 502.1.2 (Supp)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ELEMENT,
MAXIMUM U-FACTORS, C-FACTORS AND F-FACTORS

(No change to table entries)

Reason: This proposal brings the total UA alternate method of compliance which is already in Chapter 4 of the IECC for residential buildings into Chapter 5 for commercial buildings, and adds a similar provision for total SHGCA. The UA method applies to the entire building envelop, while the SHGCA only applies to the glazed portion of the building envelop.

Both methods permit compliance with the IECC to be achieved when the combination of components used achieves the same performance level as that prescribed by Chapter 5 of the IECC. This concept of establishing a target average U-factor for the building components was the basis of the original CABO Model Energy Code, which was the predecessor to the ICC International Energy Conservation Code. Through many iterations other methods of compliance have been added to the IECC, but this basic one has been lost and should be retained.

A similar proposal was submitted last cycle and approved by the IECC committee. The proponent, however, withdrew the proposal prior to Final Action in Rochester. The committee action on this previous proposal was valid and we ask that they once again approve extending this concept into the commercial provisions of the IECC.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Disapproved

Committee Reason: The committee was not convinced that averaging SHGC values gives realistic solutions, even on small buildings.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Julie Ruth, JRuth Code Consulting, representing AAMA, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

502.1.3 Total UA ~~and total SHGCA~~ alternative.

502.1.3.1 Total UA. (No change to proposed text)

~~**502.1.3.2 Total SHGCA.** If the total proposed building fenestration (vertical fenestration plus skylight) SHGCA (sum of SHGC times fenestration area for each fenestration type) is less than or equal to the total standard building SHGCA resulting from using the fenestration SHGC in Table 502.3, the building shall be considered in compliance with Tables 502.2(1) and 502.3.~~

~~For this calculation, the standard building fenestration areas shall be determined in accordance with the following:~~

1. ~~If the proposed building vertical fenestration area does not exceed the maximum vertical fenestration area allowed in Table 502.3 and the skylight area does not exceed the maximum skylight area in Table 502.3, the standard assembly areas shall be the same as the proposed building assembly areas.~~
2. ~~If the proposed vertical fenestration area exceeds the maximum vertical fenestration area allowed in Table 502.3, then the standard building shall use the maximum vertical fenestration area allowed in Table 502.3.~~
3. ~~If the proposed building skylight area exceeds the maximum skylight area allowed in Table 502.3, then the standard building shall use the maximum skylight area allowed in Table 502.3.~~

(Portions of proposal not shown remain unchanged)

Commenter's Reason: EC108 sought to return to the IECC one of the basic original model energy code concepts that the IECC is based upon. This is the concept of reducing heat loss/heat gain through the building envelop by establishing a maximum average U-factor for it. The prescriptive tables that currently exist in the IECC are based upon this concept and were developed by the U.S. Department of Energy to make compliance with the model energy codes easier to understand and enforce. Average U-factor provisions for residential construction still remain in the IECC and IRC through the total UA provisions given in Section 402.1.4 of the IECC and Section R1102.1.3 of the IRC.

As originally submitted, EC108 permitted the averaging of both U-factor for the entire building envelop, and SHGC for all the glazing in the exterior building envelop. During the code development hearings in Palm Springs some question was raised as to whether or not averaging of SHGC was appropriate. Without attempting to address that question one way or another, this Public Comment simply removes the provisions for averaging of SHGC and seeks approval of the provisions for averaging U-factor.

Final Action: AS AM AMPC____ D

EC109-07/08
502.2.1, 502.2.3, Table 502.2(1), Table 502.2(2)

Proposed Change as Submitted:

Proponent: Brad Rowe, Thermal Design, Inc.

1. Revise as follows:

502.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table 502.2(1), based on construction materials used in the roof assembly.

Exceptions:

1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25.4 mm) or less and where the area weighted *U*-factor is equivalent to the same assembly with the *R*- value specified in Table 502.2(1).
2. Metal buildings shall be as specified in Table 502.1.2.

502.2.3 Above-grade walls. The minimum thermal resistance (*R*-value) of the insulating material(s) installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Table 502.2(1), based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units (CMU) shall not be used in determining compliance with Table 502.2(1). "Mass walls" shall include walls weighing at least (1) 35 pounds per square foot (170 kg/m^2) of wall surface area or (2) 25 pounds per square foot (120 kg/m^2) of wall surface area if the material weight is not more than 120 pounds per cubic foot (1,900 kg/m^3).

Exception: Metal building walls shall be as specified in Table 502.1.2.

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Roofs								
Metal buildings[d] (with R-5 thermal blocks[a])~~b~~	No change	No change	No change	No change	No change	No change	No change	No change
Walls, Above Grade								
Metal Building~~b~~ [d]	No change	No change	No change	No change	No change	No change	No change	No change

(Portions of table not shown remain unchanged)
For SI: 1 inch = 25.4 mm.
ci – Continuous Insulation
NR – No Requirement

~~a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.~~
~~b. Assembly descriptions can be found in Table 502.2(2).~~
~~c~~ a. R-5.7 ci maybe substituted with concrete block walls complying withASTMC90, ungrouted or partially grouted at 32 in. or less on center vertically and 48 in. or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-f 2 F.
~~d~~ b. When heated slabs are placed below grade, below grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.
~~e~~ c. Insulation is not required for mass walls in Climate Zone 3A located below the "Warm-Humid" line, and in Zone 3B.
d. See TABLE 502.1.2 BUILDING ENVELOPE REQUIREMENTS – OPAQUE ELEMENT, MAXIMUM U-FACTORS.

2. Delete table without substitution:

~~**TABLE 502.2(2)**~~
~~**METAL BUILDING ASSEMBLY DESCRIPTIONS**~~

Reason: The prescriptive packages listed in Table 502.2(1) and Table 502.2(2) for metal building roofs and walls under typical installation conditions will not achieve the prescribed U-factors in Table 502.1.2.

Table 502.2(2) describes the metal building assembly descriptions and references AHRAE/IESNA 90.1 Table A2.3 and Table A3.2. The U-values that have appeared since ASHRAE 90.1-2001 Standard were provided by the North American Insulation Manufacturers Association (NAIMA) in a report entitled "Summary of Finite Element Modeling of NAIMA Roof Systems". These U-values were calculated using finite element modeling with unrealistic assumptions for typical metal building insulation assemblies.. NAIMA has admitted that they do not know the installed thicknesses required to achieve these U-values contained in their report nor what it means to be "installed correctly" in order to achieve the U-value performances that NAIMA has published and ASHRAE has adopted.

The purpose of the proposed change is to clarify the code for insulating metal buildings. There is a lack of credible and conclusive information to link the R-values listed in Table 502.2(1), 502.2(2) with the U-values in Table 502.1.2 and thus making the code inadequate in reaching the maximum U-values. A contradicting report from Oak Ridge National Laboratory shows the roof packages listed in Table 502.2(2) is overstated by at least 20% after completing hot box testing (ASTM C 1363). Although the report contained information on one type of fabric liner system, there are numerous high performance insulation systems for metal buildings which have been available in the market for decades, this includes fabric liner systems and foam board systems. This will improve the code by not allowing inaccurate prescriptive paths to meet the true intentions of the code.

Bibliography:
Thomas W. Petrie, Research Engineer, Oak Ridge National Laboratory, "*Tests of Standing-Seam Metal Roof Assemblies*", April 20th, 2007.

Cost Impact: The code change proposal will not increase the cost of construction.

Errata: The following corrections are noted in the monograph: In the row entitled "Metal building" replace "No change" with "Not available".

Committee Action: Disapproved

Committee Reason: There were concerns from the committee that, given that the errata in the document was just now being called to their attention, that the proponent needed to review the proposal and bring it back to the process when it is ready.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Casey Harkins, Thermal Design, Inc., representing himself, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

Climate Zone	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Roofs								
Metal buildings (with R-5 thermal blocks[a])[b]	~~R-19 + R-10~~ R-11 + R-19 ls	~~R-19~~ R-11 + R-19 ls	~~R-19~~ R-11 + R-19 ls	~~R-19~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-25 ls	~~R-19~~ R-11 + R-30 ls	~~R-19 + R-10~~ R-11 + R-30 ls	~~R-19 + R-10~~ R-11 + R-11 + R-25 ls

For SI: 1 inch = 25.4 mm.
ci – Continuous Insulation
ls – Liner System
NR – No Requirement

TABLE 502.2(2)
METAL BUILDING ASSEMBLY DESCRIPTIONS

ROOFS	DESCRIPTION	REFERENCE
R-11 + R-19 ls	Liner system. A continuous vapor barrier liner is installed below the purlins and uninterrupted by framing members. One layer of uncompressed, unfaced R-19 insulation rests on top of the liner between the purlins. A second layer of unfaced R-11 insulation is draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1-2007 Addendum g
R-11 + R-25 ls	Liner system. A continuous vapor barrier liner is installed below the purlins and uninterrupted by framing members. One layer of uncompressed, unfaced R-25 insulation rests on top of the liner between the purlins. A second layer of unfaced R-11 insulation is draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1-2007 Addendum g
R-11 + R-30 ls	Liner system. A continuous vapor barrier liner is installed below the purlins and uninterrupted by framing members. One layer of uncompressed, unfaced R-30 insulation rests on top of the liner between the purlins. A second layer of unfaced R-11 insulation is draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1-2007 Addendum g
R-11 + R-11 + R-25 ls	Liner system. A continuous vapor barrier liner is installed below the purlins and uninterrupted by framing members. One layer of uncompressed, unfaced R-11 insulation and one layer of uncompressed, unfaced R-25 insulation rests on top of the liner between the purlins. A third layer of unfaced R-11 insulation is draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1-2007 Addendum g

TABLE 502.1.2
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ELEMENT, MAXIMUM U-FACTORS

Climate Zone	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Roofs								
Metal buildings (with R-5 thermal block)	~~U-0.065~~ U-0.035	~~U-0.065~~ U-0.035	~~U-0.065~~ U-0.035	~~U-0.065~~ U-0.031	~~U-0.065~~ U-0.031	~~U-0.065~~ U-0.029	~~U-0.052~~ U-0.029	~~U-0.052~~ U-0.026

(Portions of proposal not shown remain unchanged)

Commenter's Reason: The current metal building roof requirements are based on thermal modeling of assemblies which cannot be achieved with current construction practices. These assemblies are likely performing at least 20% below the intended level in actual constructions. The original code change proposal asked for these assemblies to be removed from the code, leaving only the U-Value requirements in place. This comment, based on the suggestions of the Energy Committee at the public hearing in Palm Springs, instead proposes replacing these erroneous assemblies with new requirements based on the economic optimization spreadsheet and parameters that will be utilized by ASHRAE in development of the forthcoming 90.1-2010 Standard.

This issue arises from the improper assumption in the original thermal modeling of these over-the-purlin assemblies that the installed insulation recovers to its full nominal thickness across the majority of the purlin space. This is simply not possible to achieve with current construction practices (Christianson, 2007). Some of the major factors affecting the installed thicknesses of these assemblies include the length of insulation available, between the purlin bracing and the need to align and seal the seams on consecutive runs of the laminated metal building insulation (Harkins, 2008). These factors not only prevent actual installations from achieving the modeled assumptions, but indicate that it is impractical to install these materials in any other manner. The thicknesses that are reasonably obtainable have been determined by laboratory thickness testing and verified against field surveys of actual metal buildings (Christianson, 2007; Christianson, 2008). There is no question that these assemblies as they are installed in the field are not performing as intended in the IECC requirements. If code compliance officials were given the information necessary to inspect these installations for compliance and were able to get up in a lift to physically inspect the installed insulation thicknesses, most if not all metal buildings would be rejected for not complying with the code requirements.

The U-Factors for the current assemblies could be corrected utilizing effective R-Values derived from the modeling, testing and research done at the University of Illinois and ASTM C 1363 guarded hot box testing conducted at Oak Ridge National Laboratory (Christianson, 2007; Petrie, 2007; Harkins, 2007). However, doing so would effectively codify the 20% reduction in performance that is already happening in the field. Further, the corrected requirements would not be economically justified. Fortunately, ASHRAE 90.1-2007 Addendum g and the economic parameters ASHRAE SSPC 90.1 has settled on for development of the 90.1-2010 Standard leads us to a solution which both removes the requirements for these erroneous assemblies and provides for an economically justified increase in stringency for the metal building roof requirements.

Addendum g to ASHRAE 90.1-2007 has passed the public review process with no unresolved comments and is scheduled to be heard for publication at the ASHRAE Summer Meeting in Salt Lake City in June. This addendum adds an additional type of metal building insulation assembly called a liner system (ASHRAE, 2007). These liner system assemblies have been available on the market for over 25 years and are now available from most if not all of the major metal building laminators, directly from at least one insulation manufacturer, and through other suppliers. Liner system insulation systems for metal buildings separate the vapor barrier from the insulation, allowing the vapor barrier to be installed below the purlins where it belongs, creating a platform to rest one or more layers of uncompressed insulation between the purlins. An additional thin layer of insulation may be installed over the top and perpendicular to the purlins as a thermal break and to fill the space between the purlin and roof sheet.

The proposed modifications in this comment are derived from the same optimization spreadsheet used to develop Addendum g, but utilizes the scalar ratio, heating cost and cooling cost being used for ASHRAE 90.1-2010. Addendum g was originally intended as a modification to 90.1-2004 which would have taken effect in the 90.1-2007 Standard and therefore used the economic parameters (scalar ratio and energy costs) for 90.1-2007, not those for 90.1-2010. The result of this envelope optimization is that it replaces all fully conditioned metal building roof requirements with liner system assemblies (EnvOpt, 2008). These will most likely be the requirements for metal building roofs in the 90.1-2010 Standard, as acknowledged by the North American Insulation Manufacturers Association (NAIMA) in a presentation to the ASHRAE SSPC 90.1 Envelope Subcommittee in April, 2008. This economic optimization produces the same requirements for non-residential metal building roofs regardless of whether the U-Values of the over-the-purlin assemblies are corrected to reflect current construction practices or not. The changes proposed in this comment solve the problem of the erroneous assemblies by replacing them with higher performing assemblies that are economically justified, do not suffer from invalid assumptions about field installations, are able to be installed in a consistent manner to achieve the desired performance and place the vapor barrier below the purlins where it belongs.

Bibliography

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Harkins, Casey. 2008. Installation Profiles of “over-the-purlin” Roof Insulation Systems In Metal Buildings. Thermal Design, Inc. Stoughton, WI.

Petrie, Thomas. 2007. Tests of Standing Seam Roof Assemblies. Report prepared by Oak Ridge National Laboratory, Building Technology Center, 31 August, Knoxville, TN.

Final Action: AS AM AMPC____ D

EC110-07/08

Table 502.2(1), Table 502.1.2, Table 502.3

Proposed Change as Submitted:

Proponent: Steve Ferguson, American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)

Revise tables as follows:

Table 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Roofs								
Insulation entirely above deck	R-15 ci	R-~~15~~20 ci	R-~~15~~20 ci	R-~~15~~20 ci	R-20 ci	R-20 ci	R-~~25~~20 ci	R-~~25~~20 ci
Metal buildings (with R-5 thermal blocks[a])[b]	R-19+ R-10	R-19	R-19	R-19	R-19	R-19	R-19 + R-10	R-19 + R-10
Attic and other	R-30	R-~~30~~38	R-~~30~~38	R-~~30~~38	R-~~30~~38	R-~~30~~38	R-38	R-~~38~~49
Walls, Above Grade								
Mass	NR	~~NR~~R-5.7 ci[c]	R-~~5.7~~7.6 ci~~[c,e]~~	R-~~5.7~~9.5 ci~~[e]~~	R-~~7.6~~11.4 ci	R-~~9.5~~ 13.3 ci	R-~~11.4~~15.2 ci	R-~~13.3~~15.2 ci
Metal building[b]	R-13	R-13	R-13	R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13
Metal framed	R-13	R-13	R-13 + R-3.8 ci	R-13 + R-7.5 ci	R-13 + R-~~3.8~~7.5 ci	R-13 + R-~~3.8~~7.5 ci	R-13+ R-7.5 ci	R-13+ R-7.5 ci

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Wood framed and other	R-13	R-13	R-13	R-13	R-13 + R-3.8 ci	R-13 + R-7.5 ci	R-13 + R-7.5 ci	R-13+ R-~~7.5~~15.6 ci
Walls, Below Grade								
Below grade wall[d]	NR	NR	NR	NR	~~NR~~R-7.5 ci	~~NR~~R-7.5 ci	R-7.5 ci	R-7.5 ci
Floors								
Mass	NR	R-~~5~~6.3 ci	R-~~5~~6.3 ci	R-~~10~~8.3 ci	R-10.4 ci	R-~~10~~12.5 ci	R-~~15~~12.5 ci	R-~~15~~14.6 ci
Joist/Framing	NR	R-19	R-19	R-~~19~~30	R-~~19~~30	R-30	R-30	R-~~30~~38
Slab-on-Grade Floors								
Unheated slabs	NR	NR	NR	NR	NR	~~NR~~R-10 for 24 in. below	~~NR~~R-15 for 24 in. below	R-~~10~~15 for 24 in. below
Heated slabs	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-~~7.5~~10 for ~~12~~24 in. below	R-~~7.5~~15 for ~~12~~24 in. below	R-~~7.5~~15 for ~~12~~24 in. below	R-~~10~~15 for ~~36~~24 in. below	R-~~10~~20 for ~~36~~24 in. below	R-~~10~~20 for 48 in. below
Opaque Doors								
Swinging	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-~~0.70~~0.50	U-0.50
Roll-up or sliding	U-1.45	U-1.45	U-1.45	U-~~1.45~~0.50	U-~~1.45~~0.50	U-0.50	U-0.50	U-0.50

For SI: 1 inch = 25.4 mm

ci – Continuous Insulation

NR – No Requirement

a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.
b. Assembly descriptions can be found in Table 502.2(2).
c. R-5.7 ci may be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 in. or less on center vertically and 48 in. or less on center horizontally, with ungrouted cores, filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-ft^2 F.
d. When heated slabs are placed below grade, below grade walls must be meet exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.
~~e. Insulation is not required for mass walls in Climate Zone 3A located below the "Warm-Humid" line, and in Zone 3B.~~

TABLE 502.1.2 (Supp)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ELEMENT, MAXIMUM U-FACTORS

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Roofs								
Insulation entirely above deck	U-0.063	~~U-0.063~~ U-0.048	~~U-0.063~~ U-0.048	~~U-0.063~~ U-0.048	U-0.048	U-0.048	~~U-0.039~~ U-0.048	~~U-0.039~~ U-0.048
Metal buildings (with R-5 thermal blocks[a])[b]	U-0.052	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.052	U-0.052
Attic and other	U-0.034	~~U-0.034~~ U-0.027	~~U-0.034~~ U-0.027	~~U-0.034~~ U-0.027	~~U-0.034~~ U-0.027	~~U-0.034~~ U-0.027	U-0.027	~~U-0.027~~ U-0.021
Walls, Above Grade								
Mass	U-0.580	~~U-0.580~~ U-0.151	~~U-0.151~~ U-0.123	~~U-0.151~~ U-0.104	~~U-0.123~~ U-0.090	~~U-0.104~~ U-0.080	~~U-0.090~~ U-0.071	~~U-0.080~~ U-0.071
Metal building[b]	U-0.113	U-0.113	U-0.113	U-0.113	U-0.057	U-0.057	U-0.057	U-0.057
Metal framed	U-0.124	U-0.124	~~U-0.124~~ U-0.084	~~U-0.124~~ U-0.064	~~U-0.084~~ U-0.064	~~U-0.084~~ U-0.064	U-0.064	U-0.064
Wood framed and other	U-0.089	U-0.089	U-0.089	U-0.089	~~U-0.089~~ U-0.064	~~U-0.089~~ U-0.051	~~U-0.089~~ U-0.051	~~U-0.051~~ U-0.036
Walls, Below Grade								
Below grade wall[d]	C-1.140	C-1.140	C-1.140	C-1.140	~~C-1.140~~ C-0.119	~~C-1.140~~ C-0.119	C-0.119	C-0.119
Floors								
Mass	U-0.322	~~U-0.123~~ U-0.107	~~U-0.123~~ U-0.107	~~U-0.076~~ U-0.087	~~U-0.076~~ U-0.074	~~U-0.076~~ U-0.064	~~U-0.055~~ U-0.064	~~U-0.055~~ U-0.057
Joist/Framing	U-0.350	U-0.052	U-0.052	~~U-0.052~~ U-0.038	~~U-0.052~~ U-0.038	U-0.038	U-0.038	~~U-0.038~~ U-0.032
Slab-on-Grade Floors								
Unheated slabs	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	~~F-0.730~~ F-0.540	~~F-0.730~~ F-0.520	~~F-0.540~~ F-0.520
Heated slabs	F-1.020	F-1.020	~~F-1.020~~ F-0.900	~~F-1.020~~ F-0.860	~~F-0.950~~ F-0.860	~~F-0.840~~ F-0.860	~~F-0.840~~ F-0.843	~~F-0.780~~ F-0.688

TABLE 502.3 (Supp)
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 Except Marine	5 and Marine 4	6	7	8
Vertical Fenestration (40% maximum of above-grade wall)								
***U*-Factor**								
Framing materials other than metal with or without metal reinforcement or cladding								
U-Factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain Wall/Storefront *U*-Factor	1.0	0.70	0.60	0.50	0.45	0.45	~~0.45~~ 0.40	~~0.45~~ 0.40
Entrance Door *U*-Factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All Other *U*-Factor[a]	1.20	0.75	0.65	0.55	0.55	0.55	~~0.50~~ 0.45	~~0.50~~ 0.45
SHGC-All Frame Types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	~~NR~~ 0.45	~~NR~~ 0.45
SHGC: 0.25 ≤ PF <0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
U-Factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.
PF = Projection factor (See Section 502.3.2)

a. All others include operable windows, fixed windows and non-entrance doors.

Reason: The proposed changes come from addenda "as" and "at" to ANSI/ASHRAE/IESNA Standard 90.1-2004. These addenda have been incorporated into ANSI/ASHRAE/IESNA Standard 90.1-2007. The revised criteria are based on 2006 construction costs and fuel prices and went through the ANSI/ASHRAE/IESNA Standard 90.1 public review process.

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: **Disapproved**

Committee Reason: Disapproval was based upon action taken on EC106-07/08.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Steve Ferguson, representing ASHRAE, requests Approval as Submitted.

Commenter's Reason: This proposal follows the current format of the IECC while EC106, which was approved at the hearings, includes nonresidential and residential requirements from ANSI/ASHRAE/IESNA Standard 90.1-2007. Should EC106 be disapproved, this proposal would allow increased stringency compared to the 2006 IECC while maintaining the same format as Table 502.2 (1) from the 2006 IECC and 502.2 (3) from the 2007 supplement. The criteria correspond to the nonresidential criteria in Standard 90.1-2007. Should EC106 be disapproved, this proposal allows continuity with ANSI/ASHRAE/IESNA SSPC 90.1.

The proposed changes come from addenda "as" and "at" to ANSI/ASHRAE/IESNA Standard 90.1-2004. These addenda have been incorporated into ANSI/ASHRAE/IESNA Standard 90.1-2007. The revised criteria are based on 2006 construction costs and fuel prices and went through the ANSI/ASHRAE/IESNA SSPC 90.1 public review process.

Note that this proposal includes revised criteria for fenestration that was not included in EC106.

Public Comment 2:

Steve Ferguson, representing ASHRAE, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

~~TABLE 502.2(1)~~
~~BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES~~

~~CLIMATE ZONE~~	~~1~~	~~2~~	~~3~~	4 ~~except Marine~~	~~5 and Marine 4~~	~~6~~	~~7~~	~~8~~
~~Roofs~~								
~~Insulation entirely above deck~~	~~R-15 ci~~	~~R-20 ci~~	~~R-20 ci~~	~~R-20 ci~~	~~R-20 ci~~	~~R-20 ci~~	~~R-20 ci~~	~~R-20 ci~~
~~Metal buildings (with R-5 thermal blocks[a])[b]~~	~~R-19+ R-10~~	~~R-19~~	~~R-19~~	~~R-19~~	~~R-19~~	~~R-19~~	~~R-19 + R-10~~	~~R-19 + R-10~~
~~Attic and other~~	~~R-30~~	~~R-38~~	~~R-38~~	~~R-38~~	~~R-38~~	~~R-38~~	~~R-38~~	~~R-49~~
~~Walls, Above Grade~~								
~~Mass~~	~~NR~~	~~R-5.7 ci[c]~~	~~R-7.6ci[c,e]~~	~~R-9.5 ci[c]~~	~~R-11.4 ci~~	~~R-13.3 ci~~	~~R-15.2 ci~~	~~R-15.2 ci~~
~~Metal building[b]~~	~~R-13~~	~~R-13~~	~~R-13~~	~~R-13~~	~~R-13 + R-13~~	~~R-13 + R-13~~	~~R-13 + R-13~~	~~R-13 + R-13~~
~~Metal framed~~	~~R-13~~	~~R-13~~	~~R-13 + R-3.8 ci~~	~~R-13 + R-7.5 ci~~	~~R-13 + R-7.5 ci~~	~~R-13 + R-7.5 ci~~	~~R-13+ R-7.5 ci~~	~~R-13+ R-7.5 ci~~
~~Wood framed and other~~	~~R-13~~	~~R-13~~	~~R-13~~	~~R-13~~	~~R-13 + R-3.8 ci~~	~~R-13 + R-7.5 ci~~	~~R-13 + R-7.5 ci~~	~~R-13+ R-15.6 ci~~
~~Walls, Below Grade~~								
~~Below grade wall[d]~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~R-7.5 ci~~	~~R-7.5 ci~~	~~R-7.5 ci~~	~~R-7.5 ci~~
~~Floors~~								
~~Mass~~	~~NR~~	~~R-6.3 ci~~	~~R-6.3 ci~~	~~R-8.3 ci~~	~~R-10.4 ci~~	~~R-12.5 ci~~	~~R-12.5 ci~~	~~R-14.6 ci~~
~~Joist/Framing~~	~~NR~~	~~R-19~~	~~R-19~~	~~R-30~~	~~R-30~~	~~R-30~~	~~R-30~~	~~R-38~~
~~Slab-on-Grade Floors~~								
~~Unheated slabs~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~R-10 for 24 in. below~~	~~R-15 for 24 in. below~~	~~R-15 for 24 in. below~~
~~Heated slabs~~	~~R-7.5 for 12 in. below~~	~~R-7.5 for 12 in. below~~	~~R-10 for 24 in. below~~	~~R-15 for 24 in. below~~	~~R-15 for 24 in. below~~	~~R-15 for 24 in. below~~	~~R-20 for 24 in. below~~	~~R-20 for 48 in. below~~
~~Opaque Doors~~								
~~Swinging~~	~~U-0.70~~	~~U-0.70~~	~~U-0.70~~	~~U-0.70~~	~~U-0.70~~	~~U-0.70~~	~~U-0.50~~	~~U-0.50~~
~~Roll-up or sliding~~	~~U-1.45~~	~~U-1.45~~	~~U-1.45~~	~~U-0.50~~	~~U-0.50~~	~~U-0.50~~	~~U-0.50~~	~~U-0.50~~

~~For SI: 1 inch = 25.4 mm~~
~~ci – Continuous Insulation~~
~~NR – No Requirement~~
~~a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.~~
~~b. Assembly descriptions can be found in Table 502.2(2).~~
~~c. R-5.7 ci may be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 in. or less on center vertically and 48 in. or less on center horizontally, with ungrouted cores, filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-ft^2 F.~~
~~d. When heated slabs are placed below grade, below grade walls must be meet exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.~~

~~TABLE 502.2(3)~~
~~BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES~~
~~Maximum U-Factor, C-Factor, and F-Factor~~

~~CLIMATE ZONE~~	~~1~~	~~2~~	~~3~~	4 ~~except Marine~~	~~5 and Marine 4~~	~~6~~	~~7~~	~~8~~
~~Roofs~~								
~~Insulation entirely above deck~~	~~U-0.063~~	~~U-0.048~~	~~U-0.048~~	~~U-0.048~~	~~U-0.048~~	~~U-0.048~~	~~U-0.048~~	~~U-0.048~~
~~Metal buildings (with R-5 thermal blocks[a])[b]~~	~~U-0.052~~	~~U-0.065~~	~~U-0.065~~	~~U-0.065~~	~~U-0.065~~	~~U-0.065~~	~~U-0.052~~	~~U-0.052~~
~~Attic and other~~	~~U-0.034~~	~~U-0.027~~	~~U-0.027~~	~~U-0.027~~	~~U-0.027~~	~~U-0.027~~	~~U-0.027~~	~~U-0.021~~
~~Walls, Above Grade~~								
~~Mass~~	~~U-0.580~~	~~U-0.151~~	~~U-0.123~~	~~U-0.104~~	~~U-0.090~~	~~U-0.080~~	~~U-0.071~~	~~U-0.071~~
~~Metal building[b]~~	~~U-0.113~~	~~U-0.113~~	~~U-0.113~~	~~U-0.113~~	~~U-0.057~~	~~U-0.057~~	~~U-0.057~~	~~U-0.057~~
~~Metal framed~~	~~U-0.124~~	~~U-0.124~~	~~U-0.084~~	~~U-0.064~~	~~U-0.064~~	~~U-0.064~~	~~U-0.064~~	~~U-0.064~~
~~Wood framed and other~~	~~U-0.089~~	~~U-0.089~~	~~U-0.089~~	~~U-0.089~~	~~U-0.064~~	~~U-0.051~~	~~U-0.051~~	~~U-0.036~~
~~Walls, Below Grade~~								
~~Below grade wall[d]~~	~~C-1.140~~	~~C-1.140~~	~~C-1.140~~	~~C-1.140~~	~~C-0.119~~	~~C-0.119~~	~~C-0.119~~	~~C-0.119~~
~~Floors~~								
~~Mass~~	~~U-0.322~~	~~U-0.107~~	~~U-0.107~~	~~U-0.087~~	~~U-0.074~~	~~U-0.064~~	~~U-0.064~~	~~U-0.057~~
~~Joist/Framing~~	~~U-0.350~~	~~U-0.052~~	~~U-0.052~~	~~U-0.038~~	~~U-0.038~~	~~U-0.038~~	~~U-0.038~~	~~U-0.032~~
~~Slab-on-Grade Floors~~								
~~Unheated slabs~~	~~F-0.730~~	~~F-0.730~~	~~F-0.730~~	~~F-0.730~~	~~F-0.730~~	~~F-0.540~~	~~F-0.520~~	~~F-0.520~~
~~Heated slabs~~	~~F-1.020~~	~~F-1.020~~	~~F-0.900~~	~~F-0.860~~	~~F-0.860~~	~~F-0.860~~	~~F-0.843~~	~~F-0.688~~

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Vertical Fenestration (40% maximum of above-grade wall area)								
U-Factor								
Framing materials other than metal with or without metal reinforcement or cladding								
U-Factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain Wall/Storefront U-Factor	1.20	0.70	0.60	0.50	0.45	0.45	0.40	0.40
Entrance Door U-Factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All Other U-Factor[a]	1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45
SHGC – All Frame Types								
SHGC: PF<0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: 0.25≤PF≤0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF≥0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% Maximum)								
U-Factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement
PF = Projection factor (See Section 502.3.2)
a. All others includes operable windows, fixed windows, and non-entrance doors.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: The proposed changes come from addenda "as" and "at" to ANSI/ASHRAE/IESNA Standard 90.1-2004. These addenda have been incorporated into ANSI/ASHRAE/IESNA Standard 90.1-2007. The revised criteria are based on 2006 construction costs and fuel prices and went through the ANSI/ASHRAE/IESNA SSPC 90.1 public review process.

EC106, which was approved at the hearings, includes criteria for opaque assemblies but does not include these revised criteria for fenestration.

Public Comment 3:

Steve Ferguson, representing ASHRAE, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Roofs								
Insulation entirely above deck	R-15 ci	R-20 ci	R-20 ci	R-20 ci	R-20 ci	R-20 ci	R-20 ci	R-20 ci
Metal buildings (with R-5 thermal blocks[a])[b]	R-19+ R-10	R-19	R-19	R-19	R-19	R-19	R-19 + R-10	R-19 + R-10
Attic and other	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-49
Walls, Above Grade								
Mass	NR	R-5.7 ci[c]	R-7.6ci~~[c,e]~~	R-9.5 ci~~[e]~~	R-11.4 ci	R-13.3 ci	R-15.2 ci	R-15.2 ci
Metal building[b]	R-13	R-13	R-13	R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13
Metal framed	R-13	R-13	R-13 + R-3.8 ci	R-13 + R-7.5 ci	R-13 + R-7.5 ci	R-13 + R-7.5 ci	R-13+ R-7.5 ci	R-13+ R-7.5 ci
Wood framed and other	R-13	R-13	R-13	R-13	R-13 + R-3.8 ci	R-13 + R-7.5 ci	R-13 + R-7.5 ci	R-13+ R-15.6 ci
Walls, Below Grade								
Below grade wall[d]	NR	NR	NR	NR	R-7.5 ci	R-7.5 ci	R-7.5 ci	R-7.5 ci
Floors								
Mass	NR	R-6.3 ci	R-6.3 ci	R-8.3 ci	R-10.4 ci	R-12.5 ci	R-12.5 ci	R-14.6 ci
Joist/Framing	NR	R-19	R-19	R-30	R-30	R-30	R-30	R-38
Slab-on-Grade Floors								
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below
Heated slabs	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below	R-20 for 48 in. below
Opaque Doors								
Swinging	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.50	U-0.50
Roll-up or sliding	U-1.45	U-1.45	U-1.45	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50

For SI: 1 inch = 25.4 mm
ci – Continuous Insulation

NR – No Requirement

a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci may be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 in. or less on center vertically and 48 in. or less on center horizontally, with ungrouted cores, filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-ft^2 F.

d. When heated slabs are placed below grade, below grade walls must be meet exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

TABLE 502.2(3)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES
MAXIMUM U-FACTOR, C-FACTOR, AND F-FACTOR

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Roofs								
Insulation entirely above deck	U-0.063	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048
Metal buildings (with R-5 thermal blocks[a])[b]	U-0.052	U-0.065	U-0.065	U-0.065	U-0.065	U-0.065	U-0.052	U-0.052
Attic and other	U-0.034	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021
Walls, Above Grade								
Mass	U-0.580	U-0.151	U-0.123	U-0.104	U-0.090	U-0.080	U-0.071	U-0.071
Metal building[b]	U-0.113	U-0.113	U-0.113	U-0.113	U-0.057	U-0.057	U-0.057	U-0.057
Metal framed	U-0.124	U-0.124	U-0.084	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064
Wood framed and other	U-0.089	U-0.089	U-0.089	U-0.089	U-0.064	U-0.051	U-0.051	U-0.036
Walls, Below Grade								
Below grade wall[d]	C-1.140	C-1.140	C-1.140	C-1.140	C-0.119	C-0.119	C-0.119	C-0.119
Floors								
Mass	U-0.322	U-0.107	U-0.107	U-0.087	U-0.074	U-0.064	U-0.064	U-0.057
Joist/Framing	U-0.350	U-0.052	U-0.052	U-0.038	U-0.038	U-0.038	U-0.038	U-0.032
Slab-on-Grade Floors								
Unheated slabs	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	F-0.540	F-0.520	F-0.520
Heated slabs	F-1.020	F-1.020	F-0.900	F-0.860	F-0.860	F-0.860	F-0.843	F-0.688

~~**TABLE 502.3**~~
~~**BUILDING ENVELOPE REQUIREMENTS: FENESTRATION**~~

~~CLIMATE ZONE~~	~~1~~	~~2~~	~~3~~	~~4 except Marine~~	~~5 and Marine 4~~	~~6~~	~~7~~	~~8~~
~~**Vertical Fenestration (40% maximum of above-grade wall area)**~~								
~~**U-Factor**~~								
~~**Framing materials other than metal with or without metal reinforcement or cladding**~~								
~~U-Factor~~	~~1.20~~	~~0.75~~	~~0.65~~	~~0.40~~	~~0.35~~	~~0.35~~	~~0.35~~	~~0.35~~
~~**Metal framing with or without thermal break**~~								
~~Curtain Wall/Storefront U-Factor~~	~~1.20~~	~~0.70~~	~~0.60~~	~~0.50~~	~~0.45~~	~~0.45~~	~~0.40~~	~~0.40~~
~~Entrance Door U-Factor~~	~~1.20~~	~~1.10~~	~~0.90~~	~~0.85~~	~~0.80~~	~~0.80~~	~~0.80~~	~~0.80~~
~~All Other U-Factor[a]~~	~~1.20~~	~~0.75~~	~~0.65~~	~~0.55~~	~~0.55~~	~~0.55~~	~~0.45~~	~~0.45~~
~~**SHGC – All Frame Types**~~								
~~SHGC: PF<0.25~~	~~0.25~~	~~0.25~~	~~0.25~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.45~~	~~0.45~~
~~SHGC: 0.25≤PF≤0.5~~	~~0.33~~	~~0.33~~	~~0.33~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
~~SHGC: PF≥0.5~~	~~0.40~~	~~0.40~~	~~0.40~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
~~**Skylights (3% Maximum)**~~								
~~U-Factor~~	~~0.75~~	~~0.75~~	~~0.65~~	~~0.60~~	~~0.60~~	~~0.60~~	~~0.60~~	~~0.60~~
~~SHGC~~	~~0.35~~	~~0.35~~	~~0.35~~	~~0.40~~	~~0.40~~	~~0.40~~	~~NR~~	~~NR~~

~~NR = No requirement~~
~~PF = Projection factor (See Section 502.3.2)~~
~~a. All others includes operable windows, fixed windows, and non-entrance doors.~~

(Portions of proposal not shown remain unchanged)

Commenter's Reason: This proposal follows the current format of the IECC while EC106, which was approved at the hearings, includes nonresidential and residential requirements from ANSI/ASHRAE/IESNA Standard 90.1-2007. Should EC106 be disapproved, this proposal would allow increased stringency compared to the 2006 IECC while maintaining the same format as Table 502.2 (1) from the 2006 IECC and 502.2 (3) from the 2007 supplement. The criteria correspond to the nonresidential criteria in Standard 90.1-2007. Should EC106 be disapproved, this proposal allows continuity with ANSI/ASHRAE/IESNA SSPC 90.1.

The proposed changes come from addenda "as" and "at" to ANSI/ASHRAE/IESNA Standard 90.1-2004. These addenda have been incorporated into ANSI/ASHRAE/IESNA Standard 90.1-2007. The revised criteria are based on 2006 construction costs and fuel prices and went through the ANSI/ASHRAE/IESNA SSPC 90.1 public review process. This proposal is in the same format as the table in the 2006 IECC.

Final Action: AS AM AMPC____ D

EC112 -07/08
Table 502.2(1), Table 502.2(2)

Proposed Change as Submitted:

Proponent: Daniel J. Walker, PE, Thomas Associates, Inc., representing Metal Building Manufacturers Association

Revise table as follows:

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

CLIMATE ZONE	**1**	**2**	**3**	**4 except Marine**	**5 and Marine 4**	**6**	**7**	**8**
Roofs								
Metal building~~s~~[a,b] ~~(with R-5 thermal blocks[a])[b]~~	R-19 ~~+ R-10~~ ***U-0.065***	~~R-19~~ R-13 + R-13 U-0.055	~~R-19~~ R-13 + R-13 U-0.055	~~R-19~~ R-13 + R-13 U-0.055	~~R-19~~ R-13 + R-13 U-0.055	~~R-19~~ R-13 + R-19 U-0.049	~~R-19~~ R-13 + R-19 U-0.049	~~R-19 + R-10~~ R-11 + R-19 FC U-0.035
Walls, Above Grade								
Metal building[b]	~~R-13~~ R-16 U-0.093	~~R-13~~ R-16 U-0.093	~~R-13~~ R-19 U-0.084	~~R-13~~ R-19 U-0.084	~~R-13 + R-13~~ R-13 + R-5.6 ci U-0.069	~~R-13 + R-13~~ R-13 + R-5.6 ci U-0.069	~~R-13 + R-13~~ R-19 + R-5.6 ci U-0.057	~~R-13 + R-13~~ R-19 + R-5.6 ci U-0.057

(Portions of table not shown remain unchanged)

~~a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.~~

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-Factor compliance method. See Table 502.2(2).

(Re-letter subsequent notes)

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

ROOFS	**DESCRIPTION**	**REFERENCE**
~~R-19 + R-10~~	~~Filled cavity roof.~~ ~~Thermal blocks are a minimum, R-5 of rigid insulation, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin.~~ ~~This construction is R-10 insulation batts draped perpendicularly over the purlins, with enough looseness to allow R-19 batt to be laid above it, parallel to the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins. In the metal building industry, this is known as the "sag and bag" insulation system.~~	~~ASHRAE/IESNA 90.1 Table A2.3~~
R-19	Standing seam roof with single fiberglass insulation layer. ~~Thermal blocks are a minimum, R-5 of rigid insulation,~~, ~~which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin.~~ This construction is R-19 faced fiberglass insulation batts draped perpendicular~~ly~~ over the purlins. A minimum R-3.5 ~~T~~thermal spacer block~~s are then~~ is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-13 + R-13 R-13 + R-19	Standing seam roof with two fiberglass insulation layers. The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES (continued)

R-11 + R-19 FC	Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G”
WALLS		
~~R-13~~	~~Single insulation layer.~~ ~~The first layer of R-13 insulation batts is installed continuously perpendicular to the girts and is compressed as the metal skin is attached to the girts.~~	~~ASHRAE/IESNA 90.1 Table A3.2~~
~~R-13 + R-13~~	~~Double insulation layer.~~ ~~The first layer of R-13 insulation batts is installed continuously perpendicular to the girts, and is compressed as the metal skin is attached to the girts. The second layer of R-13 insulation batts is installed within the framing cavity.~~	~~ASHRAE/IESNA 90.1 Table A3.2~~
R-16, R-19	Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G”
R-13 + R-5.6 ci R-19 + R-5.6 ci	The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G”

For SI: 1 inch = 25.4 mm

Reason: This proposal corrects issues that were previously introduced into the IECC during the 2004 supplement code cycle that made the metal building provisions nearly impossible to enforce. The proposed minimum prescriptive requirements were determined using ASHRAE’s Building Envelope Criteria Generator Spreadsheet, which incorporates updated cost information for energy, insulation, labor, etc. The minimum requirements selected are significantly more stringent than both the previous referenced edition of ASHRAE 90.1 and the 2006 IECC. The introduction of U-factors that relate to the prescriptive systems listed will give designers maximum flexibility in showing compliance using the prescriptive method, especially when alternate materials or methods are desired. A new wall insulation system is introduced (fiberglass + rigid board), which is straightforward for installers and inspectors. Finally, a new roof system construction is introduced, called “filled cavity”, which has a significantly higher performance compared to the previous one shown for Climate Zone 8. The previous double layer insulation systems were difficult / impossible to install and the description was incomplete. The proposal is based on a draft addendum that has received a unanimous vote by the ASHRAE 90.1 Main Committee and is currently out for public review.

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: **Disapproved**

Committee Reason: The proposed changes would conflict with the changes proposed in EC106-07/08.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Daniel J. Walker, P.E., Thomas Associates, Inc., representing Metal Building Manufacturers Association, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

Table 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3		4 except Marine		5 and Marine 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Metal Buildings[a,b] (with R-5 thermal blocks[a])[b]	R-19 ~~+~~ ~~R-10~~ ~~U-0.065~~	R-19	~~R-19~~ R13 + R-13 ~~U-0.055~~	R13 + R-13	~~R-19~~ R13 + R-13 ~~U-0.055~~	R-19	~~R-19~~ R13 + R-13 ~~U-0.055~~	R-19	~~R-19~~ R13 + R-13 ~~U-0.055~~	R-19	~~R-19~~ R13 + R-19 ~~U-0.049~~	R-19	~~R-19~~ R13 + R-19 ~~U-0.049~~	R-19 + R-10	~~R-19 +R-10~~ R11 + R-19 FC ~~U-0.035~~	R-19 + R-10
Walls, Above Grade																
Metal Building[b]	~~R-13~~ R-16 ~~U-0.093~~	R-16	~~R-13~~ R-16 ~~U-0.093~~	R-16	~~R-13~~ R-19 ~~U-0.084~~	R-19	~~R-13~~ R-19 ~~U-0.084~~	R-19	~~R-13 + R-13~~ R-13 + R- 5.6ci ~~U-0.069~~	R-13 + R- 5.6ci	~~R-13 + R-13~~ R-13 + R- 5.6ci ~~U-0.069~~	R-13 + R- 5.6ci	~~R-13 + R-13~~ R-19 + R- 5.6ci ~~U-0.057~~	R-19 + R- 5.6ci	~~R-13 + R-13~~ R-19 + R- 5.6ci ~~U-0.057~~	R-19 + R- 5.6ci

~~a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1 inch beyond the width of the purlin on each side, perpendicular to the purlin.~~

b. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. See Tables 502.1.2 and 502.2(2).

(Re-letter subsequent notes)

Table 502.1.2 (Supp)
BUILDING ENVELOPE REQUIREMENTS OPAQUE ELEMENT, MAXIMUM U-FACTORS

CLIMATE ZONE	1		2		3		4 except Marine		5 and marine 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Metal Buildings[a,b] ~~(with R-5 thermal blocks[a])[b]~~	~~U-0.052~~ U-0.065	U-0.065	~~U-0.065~~ U-0.055	U-0.055	~~U-0.065~~ U-0.055	U-0.055	~~U-0.065~~ U-0.055	U-0.055	~~U-0.065~~ U-0.055	U-0.055	~~U-0.065~~ U-0.049	U-0.049	~~U-0.052~~ U-0.049	U-0.049	~~U-0.052~~ U-0.035	U-0.035
Walls, Above Grade																
Metal Building[~~b~~]	~~U-0.113~~ U-0.093	U-0.093	~~U-0.113~~ U-0.093	U-0.093	~~U-0.113~~ U-0.084	U-0.084	~~U-0.113~~ U-0.084	U-0.084	~~U-0.057~~ U-0.069	U-0.069	~~U-0.057~~ U-0.069	U-0.069	U-0.057	U-0.057	U-0.057	U-0.057

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

ROOFS	DESCRIPTION	REFERENCE
~~R-19 + R-10~~	~~Filled cavity roof.~~ ~~Thermal blocks are a minimum, R-5 of rigid insulation, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin.~~ ~~This construction is R-10 insulation batts draped perpendicularly over the purlins, with enough looseness to allow R-19 batt to be laid above it, parallel to the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins. In the metal building industry, this is known as the "sag and bag" insulation system.~~	~~ASHRAE/IESNA 90.1 Table A2.3~~
R-19	Standing seam roof with single fiberglass insulation layer. ~~Thermal blocks are a minimum, R-5 of rigid insulation,, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin.~~ This construction is R-19 faced fiberglass insulation batts draped perpendicular~~ly~~ over the purlins. A minimum R-3.5 ~~T~~thermal spacer block~~s are then~~ is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-13 + R-13 R-13 + R-19	Standing seam roof with two fiberglass insulation layers. The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"

ROOFS	DESCRIPTION	REFERENCE
R-11 + R-19 FC	Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES (cont'd)

WALLS		
~~R-13~~	~~Single insulation layer.~~ ~~The first layer of R-13 insulation batts is installed continuously perpendicular to the girts and is compressed as the metal skin is attached to the girts.~~	~~ASHRAE/IESNA 90.1 Table A3.2~~
~~R-13 + R-13~~	~~Double insulation layer.~~ ~~The first layer of R-13 insulation batts is installed continuously perpendicular to the girts, and is compressed as the metal skin is attached to the girts. The second layer of R-13 insulation batts is installed within the framing cavity.~~	~~ASHRAE/IESNA 90.1 Table A3.2~~
R-16, R-19	Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"
R-13 + R-5.6 ci R-19 + R-5.6 ci	The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"

Commenter's Reason: The IECC Committee's reason for disapproval at the Palm Springs hearing was that this proposed change conflicted with EC106-07/08 (approved As Submitted). Therefore, this proposal is modified to make it consistent with EC106-07/08 by adding the residential categories to Tables 502.2(1) and 502.1.2.

We believe this proposal brings the Metal Building envelope insulation levels in-line with the other construction types that were updated in EC106-07/08, which did not include any changes to the metal building requirements. If this proposal is denied, the Metal Building insulation requirements will show no change and be out-of-sync with the other construction types regulated by the IECC.

This proposal also corrects issues that were previously introduced in the IECC during the 2004 supplement code cycle that made the metal building provisions very difficult to enforce. The proposed minimum requirements that are proposed have already been approved in ASHRAE 90.1-2007 Addendum "g", and are cost justified.

Final Action: AS AM AMPC____ D

EC113-07/08
Table 502.3

Proposed Change as Submitted:

Proponent: Michael D. Fischer, The Kellen Company, representing The Window and Door Manufacturers Association (WDMA)

Revise table as follows:

TABLE 502.3 (Supp)
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 Except Marine	5 and Marine 4	6	7	8
Vertical Fenestration (40% maximum of above-grade wall)								
~~***U*-Factor**~~								
~~**Framing materials other than metal with or without metal reinforcement or cladding**~~								
~~*U*-Factor~~	~~1.20~~	~~0.75~~	~~0.65~~	~~0.40~~	~~0.35~~	~~0.35~~	~~0.35~~	~~0.35~~
~~**Metal framing with or without thermal break**~~								

CLIMATE ZONE	1	2	3	4 Except Marine	5 and Marine 4	6	7	8
Curtain Wall/Storefront *U*-Factor	1.0	0.70	0.60	0.50	0.45	0.45	0.45	0.45
Entrance Door *U*-Factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All Other *U*-Factor[a]	~~1.20~~ 1.05	~~0.75~~ 0.60	~~0.65~~ 0.55	~~0.55~~ 0.40	~~0.55~~ 0.35	~~0.55~~ 0.35	~~0.50~~ 0.35	~~0.50~~ 0.35
SHGC-All Frame Types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	NR	NR
SHGC: 0.25 ≤ PF <0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
U-Factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

(Footnote not shown remains unchanged)

Reason: This proposal will remove an existing material bias found in Table 502.3 that allows windows with metal frames to meet less restrictive U-Factor requirements. Providing separate performance requirements based upon the type of material used in the window frame is wrong, and gives special treatment to less efficient windows. To that point, the preface to the IECC contains the following statement: *"This code is founded on principles intended to establish provisions consistent with the scope of an energy conservation code that adequately conserves energy; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction."*

The current table does not reflect the guiding principles of the IECC and should be changed to provide a level playing field so that innovations in energy performance are encouraged. This proposal maintains the existing requirements for entrance door, storefront and curtain walls, while moving to one set of U-Factors for typical factory-built windows. Approval of this proposal will implement the last step necessary to transition Table 502.3 to material-neutral prescriptive performance requirements while at the same time increasing energy efficiency.

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: Disapproved

Committee Reason: The proposed U-factor of .35 for curtain walls and storefronts cannot readily be achieved with available technology.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Michael D. Fischer, The Kellen Company, representing Window and Door Manufacturers Association, requests Approval as Submitted.

Commenter's Reason: The IECC requirements that allow metal framed products to perform less efficiently than wood, vinyl and composite windows are inconsistent with ICC rules against preferential treatment to any type of material. This proposal removes such a bias and will also improve energy efficiency by ensuring that that the use of less efficient windows will be done in the context of a performance path approach so that overall envelope performance is not adversely affected. The prescriptive table as is, would allow a 36% reduction in efficiency for metal framed windows in climate zones 5 and 6, and allow it for up to 40% of the envelope. To put this into context, applying the same philosophy to some form of less efficient wall insulation material would mean R8 instead of R13. Clearly, that would never fly; allowing it for windows shouldn't either.

Public Comment 2:

Garrett A. Stone, Brickfield, Burchette, Ritts & Stone, P.C., representing Cardinal Glass Industries, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

TABLE 502.3 (Supp)
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 Except Marine	5 and Marine 4	6	7	8
Vertical Fenestration (40% maximum of above-grade wall)								
Curtain Wall/Storefront *U*-Factor	1.0	0.70	0.60	0.50	0.45	0.45	0.45	0.45
Entrance Door *U*-Factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All Other *U*-Factor[a]	1.05	0.60	0.55	0.40	~~0.35~~ 0.45	~~0.35~~ 0.45	~~0.35~~ 0.45	~~0.35~~ 0.45
SHGC-All Frame Types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	NR	NR
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
U-Factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

Commenter's Reason: The *IECC* Development Committee found on EC 114-07/08 that “Provisions of the code should be the same for all materials. This sets a different standard for different types of skylights. This does not make sense to make performance requirements different for different materials.” We agree, and we believe that the same standard should apply to EC 113.

Unfortunately, despite the fact that the present requirements for standard punched opening windows in commercial buildings vary depending on the frame type (non-metal versus metal), the Committee rejected EC 113, which would make the requirements the same for all.

The Committee reasoned: “The proposed U-factor of 0.35 for curtain walls and storefronts cannot readily be achieved with available technology.” We believe that the Committee must have mistaken the intent of the proposal. The proposal does not set 0.35 for curtain walls and storefronts; in fact, it does not change the values for these types of windows at all. The proposal only changes the values for *all other* metal windows (standard punched opening windows) to make the U-factor requirement the same for all frame types.

This proposal should be adopted as originally submitted, or at least as modified by this public comment. This proposal would save energy in climate zones 4 – 8 by eliminating an exception that allows metal windows (the majority of windows used in commercial construction) to meet far weaker requirements than non-metal windows. This is an unnecessary exception, given the wide range of windows available in these northern climates that offer a 0.35 (or lower) U-factor. EC 113 would also save energy in climate zones 1 – 3 by setting more rigorous requirements for all standard windows in these zones (1.05, 0.60 and 0.55 in these climate zones rather than 1.20, 0.75 and 0.65 respectively).

If, despite the explicit reason, the Committee was really concerned about the ability to meet 0.35 for these standard punched opening windows, this proposed modification addresses that concern. The proposed modification is to increase the requirement for all of these windows in climate zones 5 – 8 to 0.40 in order to respond to the concern that 0.35 cannot be readily achieved by available technology. Although we disagree with the concern about 0.35, as a compromise, 0.45 would provide some more room (almost 15% more heat loss/gain) for these products. It should be noted that the 2004 version of the *IECC* did not have different values for different frame types, instead differentiating by factory versus site built. In northern climates, this version of the *IECC* required 0.35 U-factor for all factory-assembled products and 0.45 for all site-assembled products. 0.45 is also the requirement for curtail wall and storefront windows. As a result, 0.45 is a reasonable compromise for standard punched opening windows.

Moreover, for any windows that do not meet the simplified prescriptive path, the performance option or ASHRAE 90.1 are both alternative compliance paths that remain available. It is vitally important, consistent with ICC’s own rules, that the *IECC* set the same standard for all material types. Moreover, it is also important that the *IECC* improve energy efficiency in commercial buildings. This proposal, either as submitted or as modified by this public comment, would achieve both of these important public policy goals.

Final Action: AS AM AMPC____ D

EC115-07/08
Table 502.3, 502.3.2

Proposed Change as Submitted:

Proponent: Garrett Stone, Brickfield Burchette Ritts & Stone, P.C., representing the Cardinal Glass Industries

Revise as follows:

TABLE 502.3 (Supp)
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 Except Marine	5 and Marine 4	6	7	8
Vertical Fenestration (40% maximum of above-grade wall)								
***U*-Factor**								
Framing materials other than metal with or without metal reinforcement or cladding								
U-Factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain Wall/Storefront *U*-Factor	1.0	0.70	0.60	0.50	0.45	0.45	0.45	0.45
Entrance Door *U*-Factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All Other *U*-Factor[a]	1.20	0.75	0.65	0.55	0.55	0.55	0.50	0.50
SHGC-All Frame Types								
SHGC: ~~PF < 0.25~~	0.25	0.25	0.25	0.40	0.40	0.40	NR	NR
~~SHGC: 0.25 ≤ PF <0.5~~	~~0.33~~	~~0.33~~	~~0.33~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
~~SHGC: PF ≥ 0.5~~	~~0.40~~	~~0.40~~	~~0.40~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
Skylights (3% maximum)								
U-Factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.
~~PF = Projection factor (See Section 502.3.2)~~
a. All others includes operable windows, fixed windows and non-entrance doors.

502.3.2 Maximum *U*-Factor and SHGC. For vertical fenestration <u>and skylights</u>, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3~~, based on the window projection factor~~. ~~For skylights, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3.~~

~~The window projection factor shall be determined in accordance with Equation 5-1.~~

~~PF = A/B~~ ~~**(Equation 5-1)**~~

~~Where:~~

~~PF = Projection factor (decimal).~~
~~A = Distance measured horizontally from the furthest continuous extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing.~~
~~B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.~~

~~Where different windows or glass doors have different *PF* values, they shall be evaluated separately, or an area-weighted *PF* value shall be calculated and used for all windows and glass doors.~~

Reason: This proposal simplifies the commercial buildings prescriptive path by eliminating projection factor trade-offs for SHGC. Users may continue to use projection factors in the more complex "total building performance" compliance path, where orientation and the specific impact of each overhang can be taken into consideration.

By eliminating complicated calculations for overhangs, the proposal simplifies compliance and enforcement efforts, consistent with the purpose of the simplified prescriptive path in section 502 of the IECC, while providing a more sure way of reducing energy cost, energy usage, peak demand, and HVAC size. The current fenestration table in the IECC allows a weaker fenestration SHGC when projection factors are incorporated into the building's design. This extra set of calculations is difficult for code officials and designers alike, because an accurate projection factor must be calculated for each window, and then worked into an area-weighted average. Similarly, the code official must inspect and measure each overhang to determine if the exception is properly applied.

Further, the SHGC trade-off is irregularly applied in the table. The trade-off ratios change depending on climate zone for no particular reason. For example, it makes no sense in climate zones 4-6 that there is no SHGC requirement once the projection factor reaches 0.25. Similarly, the values for climate zones 1-3 do not reflect accurate calculations of the effects of projection factor.

Moreover, in cases where projections (overhangs) are installed, this proposal, if adopted, will save energy, because the building will benefit from both the effect of the overhang and the lower SHGC. Since there is typically no significant cost differential between various SHGC levels for the types of fenestration specified in this table, there is no valid reason for allowing a trade-off that will simply increase overall energy use and cost in most commercial buildings. Good solar control in windows will also provide substantially increased comfort for the occupant and reduce electrical peak demands and HVAC sizing.

Projection factors can be more or less effective, depending on the orientation of the building, climate zone, reflection, and other shading considerations. The angle of the sun and the percentage of the window exposed will vary greatly depending on the orientation of the window and the location of the building. Because orientation is not a required part of the calculation, the projection factor trade-off is simply inaccurate. The projection factor trade-off is particularly problematic because it is traded off against windows with low SHGC, which consistently block unwanted heat gain regardless of the building's orientation. There is also no persuasive evidence that the trade-off values in the current table are reasonable trades, given all the variables that could affect the building's performance.

The proposed change is easier for a building official to enforce, and it allows more design freedom and greater certainty for the designer because it reduces the number of calculations and gives certain values for window performance. The proposed code change is likely, over time, to result in lower product costs due to economies of scale, inventory costs and competitive forces. Most importantly, it equalizes the stringency by removing a trade-off that is inconsistently applied and that cannot guarantee the same level of energy efficiency.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Disapproved

Committee Reason: There was no compelling technical justification for eliminating shading values in setting SHGC requirements.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Garret A. Stone, Brickfield, Brchette, Ritts & Stone, P.C., representing Cardinal Glass Industries, requests Approval as Submitted.

Commenter's Reason: This proposal:

1. Simplifies code compliance and enforcement by removing the requirement to determine the projection factor for each window in a commercial building where compliance is sought under the simple prescriptive path (the option still remains under the performance path, but in that case, the effects of each overhang are far more precisely determined through simulation software);
2. Guarantees energy savings through reasonable window SHGCs, rather than the uncertain effects of overhangs, which are highly dependent on orientation and configuration;
3. Increases energy savings by retaining both the benefits of a lower SHGC, along with the benefits of any overhangs the architect also chooses to employ (rather than having to choose and get the benefits of only one option);
4. Eliminates the incorrect trade-off currently built into the code which: (a) arbitrarily varies by climate zone; (b) is not based on a correct calculation of the effects of an overhang (indeed the calculations cannot be duplicated by use of ASHRAE projection factor information); and (c) fails to reflect differences in effects due to window orientation; and
5. Creates consistency between the commercial and residential prescriptive paths (the residential path correctly does not include a projection factor trade-off)

The *IECC* Development Committee found on EC 115 that there "was no compelling technical justification for eliminating shading values in setting SHGC requirements."

We respectfully disagree by pointing to the reasons above and the additional detailed reasons that are provided in the original reason statement for EC 115. The prescriptive path should contain only requirements that can be consistently applied and enforced, and the end result should vary as little as possible from building to building. To require a projection factor calculation for each and every window not only increases the complexity of the energy efficiency calculation, but also increases the risk of builder or inspector error. Another detailed discussion of the problems with projection factor trade-offs in prescriptive paths is also contained in our public comment to EC 25-07/08, Part II (IRC).

More importantly, the *IECC* Committee itself identified the problems with projection factors in simplified prescriptive paths when it rejected proposals to establish a similar approach in the context of the residential provisions (EC 55-07/08):

"The concept of shading as a trade-off for SHGC values needs to be dealt with on a case-by-case basis in the performance provisions. The variables that were not included were related to direction that the walls face. The concerns were that this proposal would allow a trade-off where the energy use was not actually equivalent."

The same criticisms apply whether the projection factor is used for residential or commercial buildings. The provisions presently allow a trade-off where the energy use is not equivalent. To save energy, this trade-off should be removed from the prescriptive path.

Final Action: AS AM AMPC____ D

EC116-07/08
502.3 (New), Chapter 6 (New)

Proposed Change as Submitted:

Proponent: Shirley Muns, US Green Fiber, LLC

1. Add new text as follows:

502.3 Roof reflectance. Low and medium sloped roofs in Climate Zones 1, 2, and 3 shall comply with the following requirements for reflectance when tested in accordance with ASTM C1549, E1918 or by testing with a portable reflectometer at near ambient conditions. The roof surface of low sloped roofs (2:12 or less) shall have an initial solar reflectance greater than or equal to 0.65 and shall maintain a reflectance equal or grater than 0.50 for three years after installation. Medium sloped roofs (greater than 2:12 and less than or equal to 5:12) shall have a solar reflectance equal to or greater than 0.15 initially and for three years after installation.

Exceptions:

1. The portion of the roof that is covered by a rooftop deck covering 1/3 or less of the aggregate area of the roof, or a rooftop garden, or a green roof.
2. An area including and adjacent to rooftop photovoltaic and solar thermal equipment, totaling no more than three times the area that is covered with such equipment.

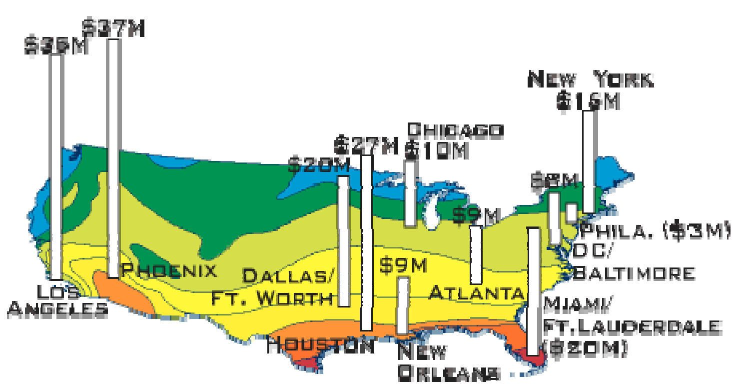
(Renumber subsequent sections)

2. Add standards to Chapter 6 as follows:

ASTM

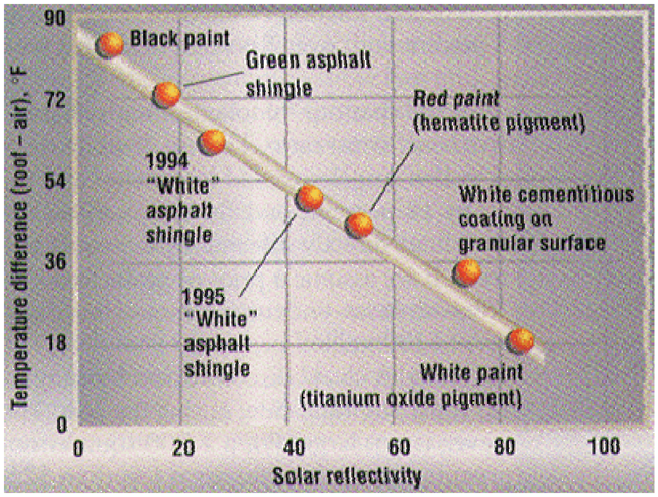
C1549-(04)	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
E1918-(1997)	Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field

Reason: Dark materials absorb more heat from the sun. Black surfaces in the sun can become up to 70°F (40°C) hotter than the most reflective white surfaces. If those dark surfaces are roofs, some of the heat collected by the roof is transferred inside. Staying comfortable under a dark shingle roof often means more air conditioning and higher utility bills. These roofs also heat the air around them, contributing to the heat island effect. Conversely, cool roofs can reduce the heat island effect and save energy. In a study funded by the U.S. EPA, the Heat Island Group carried out a detailed analysis of energy-saving potentials of light-colored roofs in 11 U.S. metropolitan areas. About ten residential and commercial building prototypes in each area were simulated. Energy Star considered both the savings in cooling and penalties in heating. We estimated saving potentials of about $175 million per year for the 11 cities. Extrapolated national energy savings were about $750 million per year.



Potential net energy savings from changing roof reflectivity. Savings are measured in dollars. The net savings are the savings of cooling energy use less the penalties of heating energy use.

The Heat Island Group has monitored buildings in Sacramento with lightly colored, more reflective roofs and found that these buildings used up to 40% less energy for cooling than buildings with darker roofs. The Florida Solar Energy Center performed a similar study, also showing up to 40% cooling energy savings.



Solar reflectivity is measured according to ASTM E903. Traditional roofing materials have an SRI of between 5% (brown shingles) and 20% (green shingles). White shingles with SRI's around 35% where popular in the 1960's, but they lost favor because they get dirty easily. The trend is to make white shingles more reflective.

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: Approved as Submitted

Committee Reason: This is an opportunity for energy efficiency with the use of readily available roofing materials.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

David S. Collins, FAIA, The Preview Group, Inc., representing The American institute of Architects, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

502.3 Roof reflectance. Low and medium sloped roofs in Climate Zones 1, 2, and 3 shall comply with the following requirements for reflectance when tested in accordance with ASTM C1549, E903, E1918 or by testing with a portable reflectometer at near ambient conditions. The roof surface of low sloped roofs (2:12 or less) shall have an initial solar reflectance greater than or equal to 0.65 and shall maintain a reflectance equal or grater than 0.50 for three years after installation. Medium sloped roofs (greater than 2:12 and less than or equal to 5:12) shall have a solar reflectance equal to or greater than 0.15 initially and for three years after installation.

Exception~~s~~:

1. ~~The portion of the roof that is covered by a rooftop deck covering 1/3 or less of the aggregate area of the roof, or a rooftop garden, or a green roof.~~
2. ~~An area including and adjacent to rooftop photovoltaic and solar thermal equipment, totaling not more than three times the area that is covered with such equipment.~~

<u>The portion of the roof that is shaded because of solar orientation, proximity to other features which shade the roof, physical features of a building such as gardens, decks, solar arrays, or roofs that are designed specifically to absorb sunlight as part of a system designed to provide a source of energy for hot water or other building needs.</u>

(Portions of proposal not shown remain unchanged)

Commenter's Reason: The AIA believes that there are significant design options available which can include the roof in the design of high efficiency buildings. The approach taken by this code change includes some of those factors, but sets arbitrary limits to 1/3 of the roof. area We believe there are significant design approaches that should be allowed to be used, instead of penalizing design solutions unnecessarily.

For example a roof with a solar array that effectively shades the entire roof, or a roof that is integrated into a hot water system may benefit from having a roof that violates these criteria. By allowing the flexibility of using a roofing system that does not meet all of these standards because it isn't exposed to solar rays may be a cost savings that would help offset the cost of such systems.

Because of the improvements to the environment being designed into many roofs, these areas are also becoming more attractive, creating other building amenities such as roof decks, which can also provide the shade to the actual roof surface, negating the need for applying standards of thermal emittance to these building elements.

Public Comment 2:

Jonathan Humble, AIA, American Iron and Steel Institute, representing same, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

~~502.3 Roof reflectance. Low and medium sloped roofs in Climate Zones 1,2, and 3 shall comply with the following requirements for reflectance when tested in accordance with ASTM C1549, E1918, or by testing with a portable reflectometer at near ambient conditions. The roof surface of low sloped roofs sloped (2:12 or less) shall have an initial solar reflectance greater than or equal to 0.65, and shall maintain a reflectance equal or greater than 0.50 three years after installation. Medium sloped roofs (greater than 2:12 and less than or equal to 5:12) shall have a solar reflectance equal to or greater 0.15 initially and for three years after installation.~~

502.3 Roof reflectance. Roofs, over conditioned space(s) that are cooled, located in Climate Zones 1, 2, and 3, shall comply with the following requirements for solar reflectance when tested in accordance with ASTM C1549 or E1918.

1. The roof surface of roofs sloped 2:12 or less shall have an minimum initial solar reflectance of 0.65, and shall have a minimum three-year aged solar reflectance of 0.50.
2. The roof surface of roofs sloped greater than 2:12 shall have a minimum initial solar reflectance of 0.25, and shall have an minimum three-year aged solar reflectance 0.15.

ASTM
C1549-(04) Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
E1918-(1997) Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field

The code challenge is proposing to modify EC116-07/08 is based upon the following:

- To delete the proposal in whole, and substitute with three simple sentences
- To address the technical inconsistencies
- To recommend changes to steep slope roof requirements

Simple Sentences:
We appreciate the proponent for succeeding in getting cool roof (a.k.a. high albedo roof) requirements into the IECC. Unfortunately, the proposal as written is complicated and contains irregularities that may render it not enforceable. As a result, our first modification request is to turn the original proposal into three simple sentences that effectively contain the same intended requirements. This will make it easy for the user to follow and for the code official to enforce.

Technical Inconsistencies:
We would propose to address the technical inconsistencies which are:

1. We would recommend that these provisions only be applicable to buildings that house conditioned spaces, and not apply to buildings with semi-heated spaces nor to buildings that are not conditioned.
2. To recognize that there are basically two types of roofs in the I-codes, that of a low-slope roof and a steep-slope roof (Defined in IBC). The modifications request a change to delete the reference to "medium-slope" roofs and substituting as appropriate with the recognized roofing terminology, that of "steep slope roofs".
3. The term "solar" was added to "reflectance" in each case for consistency with the remainder of the provision.
4. The latter portion of the first sentence has been deleted as the reference to the solar reflectormeter is inappropriate. This is covered through the reference to the ASTM test method (e.g. It is redundant).
5. We propose to delete the provisions requiring the code official to inspect the roof after a certificate of occupancy by deleting the phrase "…for three years after installation…" when referring to the aged roof requirements. As a substitute, we recommend that the roof product be tested for aged solar reflectance value as part of the provisions, and prior to selection or installation.

Steel Slope Roof Values:
We recommend changing steep-slope roofs to have both an initial and aged value consistent with current federally recognized provisions, in this case the US Environmental Protection Agency Energy Star Roof Product Regulations. The modification changes the current high-slope roof value for initial and aged from a constant 0.15 to a minimum initial value of 0.25 and a three year aged value of 0.15.

Public Comment 3:

Michael D. Fischer, The Kellen Company, representing the Asphalt Roofing Manufacturers Association, requests Disapproval.

Commenter's Reason: This proposal (EC 116) and EC 53, Parts 1 and 2, propose to include prescriptive requirements for roofing reflectivity. EC 53 was disapproved by both the IRC B/E and IECC committees, while the IECC committee approved EC 116 to address commercial applications. In disapproving EC 53, the committee reasoned that there were questions about product availability, a lack of definitions and the accuracy of the reflectivity chart. The IRC B/E committee raised questions about how to determine a test value three-years in the future without any criteria for doing so.

With all of these questions still remaining, it is surprising that the IECC committee reversed itself in approving EC 116.

ARMA asks for disapproval for the following reasons:

- There are no criteria included in the proposal to define the aged performance values, making the requirement totally unenforceable.

-The exceptions are vague and undefined and thus cannot be technically quantified and justified, and certainly cannot be enforced.
-The additional test option of the portable solar reflectometer is redundant to ASTM C1549, and opens the door to other non-consensus methods to determine the reflectance values. Without specifically defined test methods, there is no certainty that products will perform as expected.

Public Comment 4:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: This proposal adds a new provision requiring all roofs to be white. The text seems to be taken verbatim from ASHRAE 90.1. In 90.1 the provision is not a mandatory provision. In ASHRAE 90.2 the provision is an alternative practice, not a mandatory provision. Could this be a possible copyright infringement problem? The proponents had No supporting data or study results provided to reinforce this initiative. In a paper entitled 'cooling systems for hot cities". Hashem Akbari and Sarah Bretz, (funded by DOE and EPA), state that a "moderately insulated building, roof color will not make a difference". Akbari and Bretz go on to state that because cool roofs reflect the sun's heat in winter too, they can cause heating costs to rise. Another EPA study states that the reflectance of cool roofs tends to decrease over time and the larges decrease happens in the first year. EPA based their findings on a study of 10 buildings in California and Florida. These ten roofs would not be a true indication of cool roofs use throughout the country. NAHB urges your disproval for this proposal.

Public Comment 5:

Daniel J. Walker, P.E., Thomas Associates, Inc., representing the Metal Building Manufacturers Association, requests Disapproval.

Commenter's Reason: We request disapproval of this proposal for the following reasons:

1. The proposal lacks a requirement for emittance. Reflectance requirements without emittance requirements can create a situation where two products with the same reflectance, but different emittance, will not be equal in terms of energy use.
2. No requirement for roofs greater than 6:12. Although attic roof construction is prevalent for roofs greater than 6:12, many roofs are still constructed as vaulted single-rafter roofs. These roofs should not be exempt from a mandatory prescriptive cool roof requirement.
3. The proposal references the terms "reflectance", "medium sloped roofs", and "green roofs". None of these terms have been defined. In addition, the exceptions for photovoltaic systems and rooftop gardens are not defined such that they will result in equal performance compared to the required tested reflective roof products.
4. The language for 3-year values is unclear, but it seems to require building code enforcers to perform in-place testing of each roof three years after installation to show compliance with the aged requirement. Radiative properties are available now from the Cool Roof Rating Council (CRRC), which lists values for both initial and 3-year aged radiative properties. The aged values from CRRC come from weathering test farms, and are printed with the initial values on a label for each listed product.
5. "Ambient conditions" is not defined in the IECC and is likely not enforceable because it is unclear at what time day or year the roof can be evaluated to ensure the right conditions for performing the field tests.
6. The proposal contains requirements different than other established codes, standards and voluntary programs. This will cause confusion in the marketplace.
7. The proposal, as written, would allow roof product manufacturers to certify the initial product radiative performance, rather than requiring a third party agency such as CRRC.
8. The "medium" slope (2:12 to 5:12) requirement of initial and 3-year reflectance of 0.15 will not save an appreciable amount of energy. Most roofing products can already meet this level of performance, so it is unclear why a requirement of this minimal level is being proposed.
9. The proposal is not cost justified. Other approved proposals during the 07/08 IECC code cycle (such as EC106-07/08) will require increases to roof insulation, which will reduce the overall energy impact of a cool roof.

The ASHRAE 90.1 Building Envelope Subcommittee is currently working on a mandatory prescriptive cool roof proposal that has already been circulated for public review two times. Consensus has not yet been reached at ASHRAE regarding the appropriate reflectance or emittance levels, nor on the exceptions to such a requirement.

We request disapproval at this time with the hope that a proposal will be developed at ASHRAE in their technical consensus process.

Final Action: AS AM AMPC____ D

EC122-07/08

202 (New), 502.3.3 (New), 505.2.5 (New), Chapter 6 (New)

Proposed Change as Submitted:

Proponent: Julie Ruth, JRuth Code Consulting, representing the American Architectural Manufacturers Association (AAMA)

1. Add new text as follows:

SECTION 202
GENRAL DEFINITIONS

<u>**GENERAL LIGHTING:** Lighting that provides a substantially uniform level of illumination throughout an area. General lighting includes, but is not limited to, lighting by linear fluorescent luminaires (direct, indirect or direct/indirect), high bay or low bay luminaires. General lighting shall not include emergency lighting; decorative lighting or lighting that provides a dissimilar level of illumination to serve a specialized application or feature within such area.</u>

MULTI-LEVEL DAYLIGHTING CONTROLS. Systems that automatically reduce the lighting power draw in a series of at least two levels or by continuous dimming in response to availability of daylight within the interior space (sometimes referred to as "photo control").

HAZE VALUE. The ratio of diffusely transmitted light to total light transmitted.

502.3.3 Buildings with daylighting controls: Skylights meeting the following criteria shall be exempt from the SHGC requirements of Table 502.3 and the maximum percentage of gross roof assembly area that is skylights shall be 6%.

1. The haze value of the combined skylight glazing materials or diffuser in the skylight assembly is 90% or greater when tested according to ASTM D1003.
2. The skylight VLT is greater than 0.40 when determined in accordance with NFRC 200 or ASTM E972,
3. All general lighting in daylit areas under skylights is controlled by multi-level daylighting controls that comply with Section 505.2.5, and;
4. The U-factor of the skylights meet the requirements of Table 502.3.

505.2.5 Multi-level lighting controls. When multi-level lighting controls are required by this code, the general lighting in the daylight zone shall be separately controlled by at least one multi-level lighting control that reduces the lighting power in response to daylight available in the space. When the daylit illuminance in the space is greater than the rated illuminance of the general lighting of daylight zones under skylight, the general lighting shall be automatically controlled so that its power draw is no greater than 35% of its rated power. The multi-level lighting control shall be located so that calibration and set point adjustment controls are readily accessible and separate from the light sensor.

2. Add standards to Chapter 6 as follows:

ASTM

D1003-00 Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics

E972-96(2002) Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight

Reason: This proposal provides an alternative prescriptive provision for skylights that provides significant energy savings over the 2006 IECC. The alternative increases the permitted skylight area to 6% of the roof area while providing multi-level lighting controls in the daylight zones under the skylights that automatically reduce the lighting power when daylight is provided. Analysis by Carli, Inc, and the Heschong Mahone Group that was provided to the committee in previous cycles demonstrated that energy savings as great as 40% over the 2006 IECC could be achieved when this combination is used. The analyses showed that savings occur in all climate zones, even if the *U*-factor and SHGC requirements are relaxed. (Background information is available at http://www.fenestration.com/skylights.php.). A similar proposal has been approved for the next edition of ASHRAE 90.1.

A similar proposal that contained more lenient U-factors was presented to the committee last cycle and disapproved, due to concerns that energy savings might not be achieved when skylights with the higher U-factors were used in contrast to new values that were approved for all skylights during that same cycle. Further review of the analysis by Carli and Heschong Mahone Group, however, indicates that comparisons to buildings equipped with skylights that met the new criteria were made during the initial study in climate zones 4 - 8. These comparisons demonstrated that significant energy savings were achieved even when skylights with higher U-factors and SHGC were installed at 6% of the roof area, in combination with automatic lighting controls, in comparison to the installation of skylights that met the more stringent U-factor and SHGC criteria at 3% of the roof area, without automatic lighting controls.

To address the committee's concerns regarding the more lenient U-values of the previous proposal, however, this proposal establishes the maximum U-factor as that given in Table 502.3 of the IECC for prescriptive design of commercial buildings. A minimum Visible Light Transmittance (VLT) of 0.40 is also established to allow the amount of daylight needed to achieve the energy savings anticipated to travel through the skylight. Since reducing the SHGC of the skylights has an adverse effect on VLT, the skylights are exempt from the SHGC requirement of Table 502.3. The restricted maximum U-factor of 0.75 or lower from Table 502.3 will inherently also limit the SHGC of the skylights, due to the need to use special coatings and/or multiple layers of glazing to achieve these U-factors.

Based upon this combination of factors, the anticipated energy savings from the Carli study for each climate zone is given below:

Climate Zone	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Range of % energy saving over 2006 IECC	7 - 30	6 - 30	5 - 40	2 - 30	3 - 30	3 - 23	2 - 25	1 - 33
Average % energy savings over 2006 IECC	16	16	21	11	15	11	9	14

Overall this proposal is much simpler and easier to understand that the proposal previously considered by the IECC. It relies upon the definition of daylight zone under skylights that was approved during the previous ICC code change cycle as well as existing Table 502.3, while still achieving significant energy savings over the 2006 IECC.

Cost Impact: The code change proposal will not increase the cost of construction.

Analysis: Review of proposed new standard ASTM D 1003-00 indicated that, in the opinion of ICC Staff, the standard did not comply with ICC standards criteria, Section 3.6.3.1.

Committee Action: Disapproved

Committee Reason: The definition of "General lighting" includes the phrase "including, but not limited to.." which, used in this context makes the definition vague and difficult to understand.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Julie Ruth, JRuth Code Consulting, representing AAMA, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

SECTION 202
GENERAL DEFINITIONS

GENERAL LIGHTING: Lighting that provides a ~~substantially~~ uniform level of illumination throughout an area. General lighting includes, but is not limited to, lighting by linear fluorescent luminaires (direct, indirect or direct/indirect), high bay or low bay luminaires. General lighting shall not include emergency lighting; decorative lighting or lighting that provides a dissimilar level of illumination to serve a specialized application or feature within such area.

MULTI-LEVEL ~~DAY~~LIGHTING CONTROLS. Systems that automatically reduce the lighting power draw in a series of at least two levels or by continuous dimming in response to availability of daylight within the interior space (sometimes referred to as "photo control").

HAZE VALUE. (No change to proposed text)

502.3.3 ~~Buildings with~~ Minimum Daylighting ~~controls~~: In spaces enclosed by walls or floor-to-ceiling partitions that are greater than 25,000 ft^2 (2000 m^2) in area, in single story buildings of Group E, F-1, F-2, M, S-1 or S-2 occupancies, a minimum of 50% of the floor area shall be in a daylight zone. All lighting in this daylight zone shall be controlled by multi-level lighting controls that comply with Section 505.2.5.

Skylights in these spaces shall meet~~ing~~ the following criteria and shall be exempt from the SHGC requirements of Table 502.3. ~~and~~ The maximum percentage of gross roof assembly area that is skylights in these spaces shall be 6%.

1. The haze value of the combined skylight glazing materials or diffuser in the skylight assembly shall be identified by a manufacturer's designation that indicates manufacturer, testing laboratory, haze value and test method used. The haze shall be 90% or greater when tested according to ASTM D1003.
2. The skylight VLT ~~is~~ shall be greater than 0.40 when determined in accordance with ~~NFRC 200 or~~ ASTM E972.
3. All general lighting in daylit areas under skylights ~~is~~ shall be controlled by multi-level ~~day~~lighting controls that comply with Section 505.2.5, and;
4. The U-factor of the skylights shall meet the requirements of Table 502.3.

Exception: Auditoria, theaters, museums, places of worship, and refrigerated warehouses.

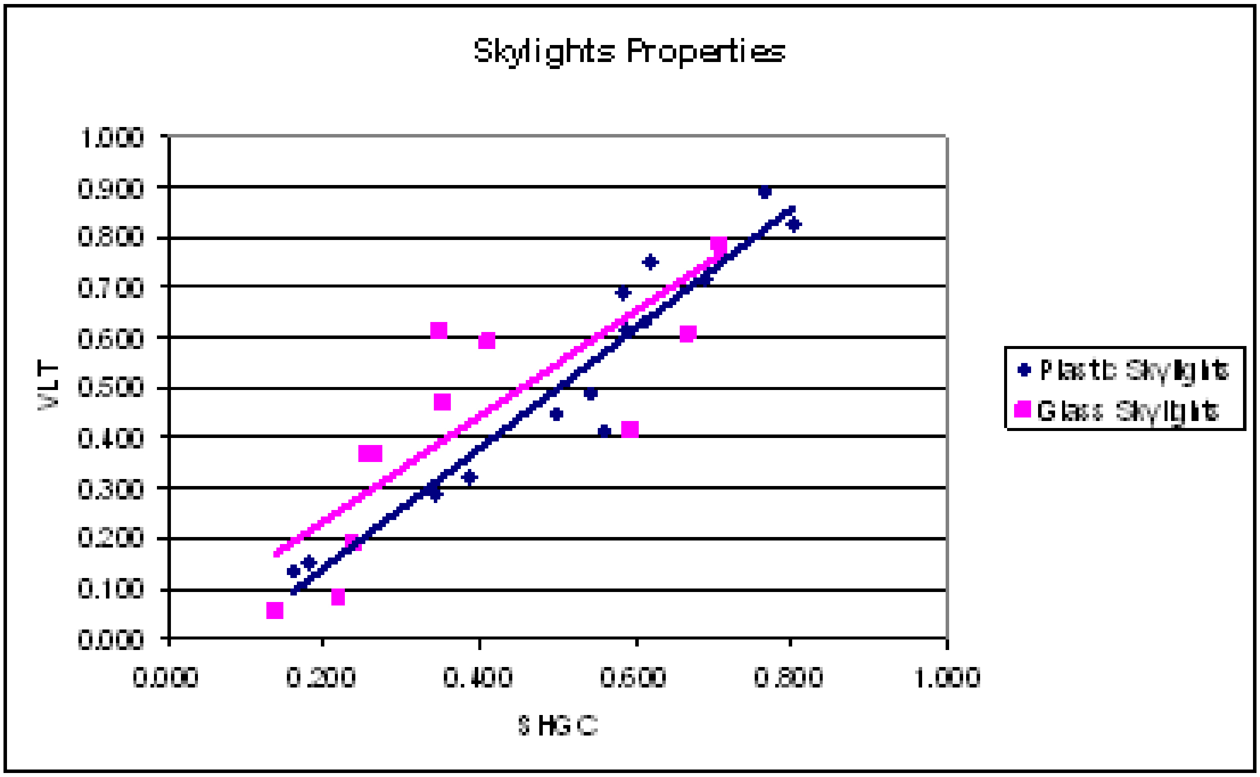
(Portion of proposal not shown remains unchanged)

Commenter's Reason: This public comment to EC122 would provide significant energy savings over the 2006 IECC for large open spaces in educational, factory, mercantile and storage occupancies by requiring a minimum floor area to be daylight, with automatic lighting controls that reduce the lighting power draw in response to the daylighting that is provided, and permitting the use of skylights that contribute appropriately to the overall amount of daylighting provided. Analysis by Carli, Inc, and the Heschong Mahone Group that was provided to the IECC committee in previous cycles demonstrated that energy savings as great as 40% over the 2006 IECC could be achieved when skylights with both higher U-factors and SHGC are installed in 6% of the roof area in a space with 12 foot high ceilings, in combination with automatic lighting controls, in comparison to the installation of skylights that met the more stringent criteria of the 2007 Supplement to the 2006 IECC for both U-factor and SHGC, at 3% of the roof area, without automatic lighting controls. (Background information is available at http://www.fenestration.com/skylights.php.). A proposal based on the same analysis has been approved for the next edition of ASHRAE 90.1.

A similar proposal that relaxed both the U-factors and SHGCs for skylights was presented to the IECC committee last cycle and disapproved. EC122, and this Public Comment, does not contain this relaxation of U-factor. Both EC122-07/08 as originally submitted, and as modified by this Public Comment, only relax the SHGC requirement for skylights

EC122, and this Public Comment, also established a minimum Visible Light Transmittance (VLT) of 0.40 for the skylights serving these spaces. This minimum VLT was assumed in the analysis referenced above, and is needed to achieve the energy savings it anticipates. VLT cannot be determined using NFRC 200, so the initially proposed reference to NFRC 200 for this purpose is removed in this Public Comment.

Since reducing the SHGC of the skylights has an adverse effect on VLT, the skylights are exempt from the SHGC requirement of Table 502.3. As SHGC goes down, so does the Visible Light Transmission of the Skylight as the below graph shows:



As can be seen, if SHGC's are too low, not enough light enters a building to get the benefit of daylighting. It should be noted that this characteristic is true for glass skylights as well as plastic skylights, with only slight variation in the linear relationship between the two characteristics. To ensure enough light comes in through toplighting, it is crucial to exempt skylights from the prescriptive SHGC's in Table 502.3.

The restricted maximum U-factor of 0.75 or lower from Table 502.3 will inherently also limit the SHGC of the skylights, due to the need to use special coatings and/or multiple layers of glazing to achieve these U-factors. Based upon this combination of factors, the anticipated energy savings from the Carli study for each climate zone is given below:

Climate Zone	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Range of % energy saving over 2006 IECC	7 - 30	6 - 30	5 - 40	2 - 30	3 - 30	3 - 23	2 - 25	1 - 33
Average % energy savings over 2006 IECC	16	16	21	11	15	11	9	14

EC122 also relied upon the definition of daylight zone that was approved for the 2007 Supplement to the 2006 IECC. This Public Comment retains that reliance.

The changes proposed in this public comment address the concerns brought up during the 2008 Code Development Hearings in Palm Springs. These include:

1. Concern was expressed that the scope of EC122 was too broad, and it should be limited to spaces of a certain size or floor area. Therefore a minimum floor area and specific occupancies, based upon the analysis conducted by Hershong Mahone and Carli, are added in this Public Comment. These additions bring EC122 more in line with current requirements in other codes such as California Title 24 and ASHRAE 90.1 Annex D.
2. Some of the commenters and committee members had concerns about the distribution of skylights in the roof area. This Public Comment adds a requirement that 50% of the floor area must be in the daylight zone. The daylit zone is defined in Chapter 2, Section 202 of the 2007 Supplement to the 2006 IECC. Requiring 50% of the floor area to be in the daylight zone will ensure that all of the skylights will not be bunched up in one small section of the roof. This addition also places the burden upon the building designer to determine the ceiling height needed to achieve the required daylight area, with skylight area limited to 6% of the roof area and vertical fenestration limited to 40% of the above grade wall of the entire building, under the prescriptive method of the IECC.
3. An IECC committee member brought up concerns that the Code Official would have no method of measuring the Haze Value of the skylight. Under this proposal manufacturers of skylights and other toplighting methods would need to report the Haze Value of the skylights, if they are used to achieve the 50% daylight area. This could be done by providing test reports to the Code Officials, but this Public Comment draft also contains a provision that the skylight carry a manufacturer's designation that indicates the haze value of the skylight, as well as the manufacturer and the test method used to determine Haze.
4. One of the committee members expressed concern that the word "substantially" in the proposed definition of general lighting was vague and unenforceable. Therefore, the word "substantially" has been deleted in this Public Comment.

Final Action: AS AM AMPC____ D

EC123-07/08

502.4.3, 502.4.3.1 (New), 502.4.3.2 (New), 502.4.3.3 (New), 502.4.3.4 (New), Chapter 6 (New)

Proposed Change as Submitted:

Proponent: Proponent: Dave Collins, AIA, The Preview Group, Inc., representing the AIA Codes Committee

1. Delete and substitute as follows:

~~**502.4.3 Sealing of the building envelope.** Openings and penetrations in the building envelope shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.~~

502.4.3 Continuous air barrier. Except in unheated structures and as permitted by this section, a continuous air barrier shall be installed and shall have all the following characteristics:

1. Continuous throughout the envelope with all joints and seams sealed and with sealed connections between all transitions in planes and changes in materials and at all penetrations.
2. Joined and sealed in a flexible manner to the air barrier component of adjacent assemblies, allowing for the relative movement of these assemblies and components.
3. Withstand positive and negative combined design wind, fan and stack pressures on the air barrier without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. Installed in accordance with the manufacturer's instructions and in such a manner as to achieve the performance requirements.
5. Penetrations of the continuous air barrier shall be made in a way such that the integrity of the continuous air barrier is maintained.

   Exception: Buildings that comply with 502.4.3.1.1 below are not required to comply with either 502.4.3 (1) or 502.4.3 (5) above.

502.4.3.1 Compliance. The materials, assemblies or full scale testing of a structure in accordance with Sections 502.4.3.2, 502.4.3.3, or 502.4.3.4. shall be used to determine compliance with Section 502.4.3.

502.4.3.2 Materials. Using individual materials that have an air permeability not to exceed 0.02 L/s·m^2 under a pressure differential of 75 Pa (0.004 cfm/ft^2 under a pressure differential of 0.3 in. water (1.57 lb/ft^2)) when tested in accordance with ASTM E2178.

502.4.3.3 Assemblies. Assemblies of materials and components shall have an average air leakage not to exceed 0.2 L/ s·m^2 @ 75 Pa (0.04 cfm/ft^2 under a pressure differential of 0.3" w.g. (1.57 psf)) when tested in accordance with ASTM E2357 or ASTM E1677. In addition these assemblies must meet the requirement for joints in accordance with Section 502.4.3.

502.4.3.4 Building. Testing the completed building and demonstrating that the air leakage rate of the building envelope does not exceed 2.0 L/s·m^2 @ 75 Pa (0.40 cfm/ft^2 at a pressure differential of 0.3" w.g. (1.57 psf)) in accordance with ASTM E779 or an equivalent approved method.

2. Add standards to Chapter 6 as follows:

ASTM

E779-99	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
E2357-05	Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

Reason: A significant source of energy loss through building envelopes is due to pressure differentials that cause infiltration and exfiltration. The most effective means to prevent this is by means of a continuous air barrier integrated into the building envelope design. An air barrier prevents loss of conditioned air, reduces loads by stabilizing interior conditions, and reduces the possibility of airborne moisture condensing within the building envelope. An air barrier can therefore reduce energy costs, promote occupant comfort and productivity, and minimize the possibility of mold growth and structural damage due to condensation. A cost/benefit analysis of air barrier installations shows a reasonable payback period in all climate zones based on current energy costs.

The AIA has committed to the 2030 Challenge, seeking to reduce emissions of greenhouse gasses in new and existing buildings to 0 by 2030. In order to achieve this goal the efficiency of all building systems, including the building envelope, must be maximized. The importance of achieving this is based upon projections of global temperature rise as a result of global warming. The construction sector worldwide contributes roughly 60% of the emissions responsible for global warming. Air barriers have been found to be a safe and effective way to achieve reduction in energy loss for over a decade in Canada and for almost ten years in Massachusetts.

Cost Impact: The code change proposal will increase the cost of construction.

Analysis: Review of proposed new standard ASTM E 779-99 indicated that, in the opinion of ICC Staff, the standard did not comply with ICC standards criteria, Section 3.6.3.1.

Committee Action: Disapproved

Committee Reason: The methodology for testing still needs some development and standardization before it is ready for inclusion in the code.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Laverne Dalgleish, Bpc Building Professionals Consortium Inc., representing Air Barrier Association of America, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

SECTION 202
GENERAL DEFINITIONS

CONTINUOUS AIR BARRIER. The combination of interconnected materials, assemblies and flexible sealed joints and components of the building envelope that provide air-tightness.

AIR LEAKAGE RATE OF THE BUILDING ENVELOPE. Q/S, the average volume of air in cubic feet per minute (liters per second) that passes through a unit area of the building envelope in square feet (square meters), expressed in cfm/ft2 (L/s.m2), where Q is the volume of air in cubic feet per minute (liters per second) flowing through the whole building envelope when subjected to an indoor/outdoor pressure of 0.3" w.g. or 1.57 psf (75 Pa) in accordance with ASTM E 779, and S, measured in square feet (square meters), is the total area of the envelope air pressure boundary including the lowest floor, any below grade walls, above-grade walls, and roof (or ceiling) (including windows and skylights) separating the interior conditioned space from the unconditioned environment.

502.4.3 Building envelope sealing. The following areas of the building envelope shall be sealed, caulked, gasketed, or weather-stripped to minimize air leakage:

1. Joints around fenestration and door frames
2. Junctions between walls and foundations, between walls at building corners, between walls and structural floors or roofs, and between walls and roof or wall panels
3. Openings at penetrations of utility services through roofs, walls, and floors
4. Site-built fenestration and doors
5. Building assemblies used as ducts or plenums
6. Joints, seams, and penetrations of air barrier all other openings in the building envelope.

The building envelope shall be designed and constructed with a *continuous air barrier* to control air leakage into, or out of, the conditioned space. All air barrier components of each envelope assembly shall be clearly identified on *construction documents* and the joints, interconnections and penetrations of the air barrier components shall be detailed. The *continuous air barrier* shall have the following characteristics and shall also comply with Section 502.4.3:

1. It shall be continuous throughout the envelope (at the lowest *floor*, exterior *walls*, and ceiling or *roof*), with all joints and seams sealed and with sealed connections between all transitions in planes and changes in materials and at all penetrations.
2. The air barrier component of each assembly shall be joined and sealed in a flexible manner to the air barrier component of adjacent assemblies, allowing for the relative movement of these assemblies and components.
3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the air barrier without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. It shall be installed in accordance with the *manufacturer's* instructions and in such a manner as to achieve the performance requirements.
5. Where lighting *fixtures* with ventilation holes or other similar objects are to be installed in such a way as to penetrate the *continuous air barrier*, provisions shall be made to maintain the integrity of the *continuous air barrier.*

   Exception: Building envelopes of buildings in climate zones 1, 2, and 3; buildings over 7 stories above grade in all climate zones; or semiheated spaces in all climate zones provided the following areas of all those *building envelopes* are sealed, caulked, gasketed, or weather-stripped to minimize air leakage:

   1. Joints around *fenestration* and *door* frames,
   2. Junctions between *walls* and foundations, between *walls* at building corners, between *walls* and structural *floors* or *roofs*, and between *walls* and *roof* or *wall* panels,
   3. Openings at penetrations of utility services through *roofs*, *walls*, and *floors*,

4. Site-built *fenestration* and *doors*,
5. Building assemblies used as ducts or plenums,
6. Joints, seams, and penetrations of vapor retarders,
7. All other openings in the *building envelope*.

502.4.3.1 Compliance. The materials, assemblies or full scale testing of a structure in accordance with Sections 502.4.3.2, 502.4.3.3, or 502.4.3.4. shall be used to determine compliance with Section 502.4.3.

502.4.3.1.1 Building materials and assemblies. The following materials comply with the requirements of 502.4.3.2.

1. Plywood - minimum 3/8” (10 mm)
2. Oriented strand board - minimum 3/8” (10 mm)
3. Extruded polystyrene insulation board - minimum 3/4” (19 mm)
4. Foil-back urethane insulation board - minimum 3/4” (19 mm)
5. Exterior or interior gypsum board - minimum 1/2” (12 mm)
6. Cement board - minimum 1/2” (12 mm)
7. Built up roofing membrane
8. Modified bituminous roof membrane
9. Fully adhered single-ply roof membrane
10. A Portland cement/sand parge or gypsum plaster minimum 5/8” (16 mm) thick
11. Cast-in-place and precast concrete.
12. Fully grouted concrete block masonry.
13. Sheet Steel.

502.4.3.2 Material air permeance testing. Using individual materials that have an air permeability not to exceed 0.02 L/s·m2 under a pressure differential of 75 Pa (0.004 cfm/ft2 under a pressure differential of 0.3 in. water (1.57 lb/ft2)) when tested in accordance with ASTM E2178.

502.4.3.2.1 Individual materials proposed as part of the *continuous air barrier* shall be tested by the *manufacturer* in accordance with ASTM E 2178. Following are comments referring to ASTM E 2178.

502.4.3.2.2 The effectiveness of fluid-applied materials in sealing a rough surface is dependent on application thickness. Fluid-applied materials shall be tested as a 1M x 1M film applied to a concrete block substrate with cells open at the top, using ASTM E 2178. This will verify the dry film thickness of material needed for an effective application, and shall be reported by the *manufacturer*.

502.4.3.3 ~~Assemblies~~ Assembly air permeance testing. Assemblies of materials and components shall have an average air leakage not to exceed 0.2 L/ s·m2 @ 75 Pa (0.04 cfm/ft2 under a pressure differential of 0.3” w.g. (1.57 psf)) when tested in accordance with ASTM E2357. In addition these assemblies must meet the requirement for joints in accordance with Section 502.4.3.

502.4.3.3.1 Assemblies of materials proposed as part of the continuous air barrier shall be tested by the manufacturer in accordance with ASTM E 2357. Metal building assemblies are allowed to be tested in accordance with ASTM E 1680.

502.4.3.3.2 Wall assemblies whose wind and gust load structural integrity has been otherwise tested or verified are allowed to be tested in accordance with ASTM E 283.

502.4.3.3.3 The following assemblies comply with the requirements of 5.4.3.1.2(b).

1. Assemblies that include a continuous air barrier material and comply with ASTM E 2357 and 5.4.3.1.2(b)
2. Concrete masonry walls with:
   - 2.1. One application of block filler and two applications of a paint or sealer coating, or
   - 2.2. A Portland cement/sand parge stucco or plaster minimum ½” (12 mm) thick.

502.4.3.3.3.1 All joints shall be sealed and other requirements of 5.4.3.1.1 shall be complied with for the material or assembly to comply as part of a continuous air barrier.

502.4.3.4 Whole building air leakage rate testing. Testing the completed building and demonstrating that the air leakage rate of the building envelope does not exceed 2.0 L/s·m2 @ 75 Pa (0.40 cfm/ft2 at a pressure differential of 0.3” w.g. (1.57 psf)) in accordance with ASTM E779 or an equivalent approved method.

502.4.3.4.1 Whole building testing as the compliance method shall be accomplished in accordance with ASTM E 779 or approved similar test. Tests shall be accomplished using either pressurization or depressurization or both. The building shall not be tested unless it is verified that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner. Following are comments referring to ASTM E 779:

502.4.3.4.2 Under ASTM E 779 it is permissible to test using the building’s HVAC system. In buildings with multistory HVAC systems and shafts.

502.4.3.4.3 Section 8.1 – For purposes of this test, a multi-zone building shall be configured as a single zone by opening all interior doors, and otherwise connecting the interior spaces as much as possible. It is also allowed to test a smaller section of the building, provided the test area can be isolated from neighboring conditioned zones by balancing the pressure in adjacent conditioned zones to that in the zone being tested. This can be very difficult to do in buildings with multistory shafts and HVAC systems. If a smaller section of the building is tested, provide a drawing showing the zone(s) tested, the pressure boundaries and a diagram of the testing equipment configuration.

502.4.3.4.4 Section 8.2 – Seal all intentional functional openings such as exhaust and relief louvers, grilles and dryer vents, that are not used in the test to introduce air, using plastic sheeting and duct tape or similar materials. All plumbing traps shall be filled with water.

502.4.3.4.5 Section 8.10 – The test pressure range shall be from 10 Pa to 80 Pa. If approved by the Building Official, lower test pressures are acceptable, but the upper limit shall not be less than 50 Pa.

502.4.3.4.6 Section 9.4 –If both pressurization and depressurization are not tested, plot the air leakage against the corrected ΔP for either pressurization or depressurization.

502.4.3.4.7 Section 9.6.4 –If the pressure exponent n is less than 0.5 or greater than 1, corrective work shall be performed to the *continuous air barrier* and the test shall be rerun.

502.4.3.4.8 Section 10.4 – Report the air leakage rate normalized over the area of enclosure (see 3.2 definitions, *Air Leakage Rate of the Building Enclosure*) in cfm/ft2 at 0.3" w.g. (1.57 psf) (L/s.m2 at 75 Pa).

2. Add standards to Chapter 6 as follows:

ASTM

E779-99	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
E2357-05	Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

Commenter's Reason: The reason stated for opposition to EC123 was that the wording did not harmonize with ASHRAE 90.1 Addendum Z. This public comments proposes to use the same wording as ASHRAE 90.1 Addendum Z.

Final Action: AS AM AMPC____ D

EC127-07/08
202 (New), 502.4.6

Proposed Change as Submitted:

Proponent: Stephen Turchen, Fairfax County Department of Public Works and Environmental Services, Fairfax, VA

1. Add new definition as follows:

SECTION 202
GENERAL DEFINITIONS

BUILDING ENTRANCE. Any doorway, set of doors, turnstile, or other form of portal that is ordinarily used to gain access to the building or space by its users and occupants.

2. Revise as follows:

502.4.6 Vestibules. ~~A door~~ Building entrances that separates conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. Door swing and distance between vestibule doors shall conform to Sections 1008.1.2 and 1008.1.7 of the *International Building Code*. Vestibules shall not be made part of the conditioned space of the building to which they are attached.

Exceptions:

~~1. Buildings in Climate Zones 1 and 2 as indicated in Figure 301.1 and Table 301.1.~~

~~2~~ 1. Doors not intended to be used as a building entrance ~~door~~, such as doors to mechanical or electrical equipment rooms.

~~3~~ 2. Doors opening directly from a sleeping unit or dwelling unit.

~~4~~ 3. Doors that open directly from a space less than 3,000 square feet (298 m^2) in area. Spaces that are separated from the "3000 ft^2 space" by a door or moveable partition shall not be considered part of the "3000 ft^2 space" for purposes of area computation.

~~5~~ 4. Building entrances with revolving doors. Any side-hinged swinging door required in addition to the revolving door in accordance with the 2006 IBC shall not require a vestibule.

~~6~~ 5. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

Reason: The purpose of the proposal is to clarify the IECC provisions as they to apply to vestibules for commercial buildings.
In practice, since this provision first appeared in the 2003 IECC, it has been difficult to interpret the requirements of IECC Section 502.4.6 for determining when an airlock vestibule should be added to a commercial building. What doors should be considered for vestibules? When is the space to which the door connects of a size that would require a vestibule? Answering questions like these in a logical and uniform manner has implications for both building design (and cost) and code enforcement, as well as energy conservation.

The new definition in Section 202 helps to define the class of doors that are eligible for vestibules. Only doors that are "ordinarily used to gain access" should be considered. Many doors can be used to get into a building, such as those discussed in exception #2, but they are not the primary means of access. Doors that are primarily exit discharge doors at the end of dedicated corridors or located to provide additional means of egress from large rooms are similarly ineligible, as they will not be used for "ordinary access." The inclusion of the phrase "or space" in the proposed definition is intended to account for large individual tenant spaces in strip malls or similar buildings which will have building entrance doors that open directly to the outdoors. In effect, the definition causes the designer or code official to answer the following simple question: Is this a door that will be used for significant pedestrian traffic into this building or space? If so, a vestibule will be required, unless one of the proposed exceptions applies.

Text on door swing and distance between vestibule doors was added to ensure conformity with the IBC requirements for means of egress doors. Any door qualifying as a "building entrance door" will with rare exception be an egress door for the building or space.

Text was added to the main paragraph of Sec. 502.4.6 to ensure that vestibules are not themselves separately conditioned. Vestibules will always be indirectly conditioned by the adjacent conditioned area of the building or space to which they are attached and the constant opening and closing of the interior door. The exterior door will always let in unconditioned outside air which the HVAC system will always be trying to condition, wasting energy unnecessarily, considering the short transit time of pedestrians in the vestibule. Providing this additional language will also clarify to designers that direct conditioning of vestibules is not required, another source of confusion in this area.

Exception 1 was deleted as there is no logical reason for excluding cooling-dominated climate zones from the vestibule requirement. Vestibules in these climate zones will help to prevent hot, humid air intrusion into the conditioned space, just as vestibules in heating zones will help to prevent the intrusion of cold outside air.

The addition to exception 4 will clarify how to compute the 3000 ft2 area when applying this exception, another source of confusion. One must consider only that floor area, directly adjacent to the building entrance door, which is completely bounded by walls, doors of any kind, or moveable partitions. (A <u>fixed opening</u> into an adjacent space would add the area of that adjacent space to the area directly adjacent to the building entrance door for the purposes of this exception.)

The addition to exception 5 clarifies the revolving door exemption. The IBC requires a side-hinged swinging door within 10 feet of a revolving door (Sec. 1008.1.3.1). Does the swinging door now become another "building entrance door" that needs a vestibule? The logical answer is "No," as the revolving door is considered to be providing the acceptable air-lock entry into the building or space, even though people may, on occasion, use the swinging door to gain access.

Cost Impact: The code change proposal will increase the cost of construction in those cases where vestibules are now clearly required, based on the revised language, but will decrease the cost of construction in those cases where the proposal provides enough information to determine that a vestibule is not in fact required for the building or space under consideration.

Committee Action: Disapproved

Committee Reason: The proposal would seem to prohibit different needed ways in and out of buildings. The proposal would suggest that a vestibule can never be a conditioned space, when there are times when some type of conditioning is needed, such as heaters to prevent ice build up. Therefore, this proposal essentially muddles what exactly a vestibule is.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Stephen Turchen, Fairfax County Department of Public Works, Fairfax County, VA, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

SECTION 202
GENERAL DEFINITIONS

Building Entrance. Any doorway, set of doors, turnstile, or other form of portal that is ~~ordinarily used to gain~~ <u>a primary means of gaining</u> access to the building or space by its users and occupants.

502.4.6 Vestibules. Building entrances that separate conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. Door swing and distance between vestibule doors shall conform to 2006 IBC Sec. 1008.1.2 and 1008.1.7. Vestibules shall not be made part of the conditioned space of the building to which they are attached, <u>unless required to prevent freezing of water pipes or floor surfaces within the vestibule</u>.

Exceptions:

1. Doors not intended to be used as a building entrance, such as doors to mechanical or electrical equipment rooms.-
2. Doors opening directly from a sleeping unit or dwelling unit.

3. Doors that open directly from a space that is less than 3000 ft^2 (298 m^2) in area. Spaces that are separated from the "3000 ft^2 space" by a door or moveable partition shall not be considered part of the "3000 ft^2 space" for purposes of area computation, <u>if the door or partition is self-closing</u>.
4. Building entrances with revolving doors. Any side-hinged swinging door required in addition to the revolving door in accordance with the 2006 IBC shall not require a vestibule.
5. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

Commenter's Reason: The purpose of the proposal and this public comment is to clarify when a vestibule is required in a commercial building.

One of the stated reasons for disapproval of the original proposal is "different needed ways in and out of buildings" would be prohibited. It is unclear why any door into or out of a building would be prohibited by the proposed change. The slightly modified definition in Section 202 identifies those doors that should be considered for vestibules: the ones that are "the primary means of gaining access" to the building. Many doors can be used to get into a building, but they are not the primary means of access. Doors that are exit discharge doors at the end of dedicated corridors or located to provide additional means of egress from large rooms are examples of doors that would not <u>require</u> vestibules under the proposed change, as they will not be used for primary access into the building. In effect, the definition causes the designer or code official to answer the following simple question: Is this a door that will be used for significant pedestrian traffic into this building or space? If so, a vestibule will be required, unless one of the proposed exceptions applies. Other doors become part of the building's design; they simply do not require vestibules. Note that there is nothing in the proposed language of Sec. 502.4.6 that would prevent someone from installing a vestibule at a door where the section would not otherwise require a vestibule.

Text was originally added to the main paragraph of Sec. 502.4.6 to ensure that vestibules are not themselves separately conditioned. However, the Committee felt that sometimes the vestibule should be conditioned, such as "to prevent ice build-up." A change was added to the original proposal language to permit heating if freeze protection of pipes or floor surfaces was considered a problem in some locales. Freeze protection should not be a significant issue for vestibules, as they will always be indirectly conditioned by the adjacent (heated) area of the building or space to which they are attached and the conditioning of that space via the IECC compliant building envelope. (Freeze protection of piping systems is addressed in the International Plumbing Code, Section 305.6.)

The addition to exception 3 should further clarify how to compute the 3000 ft2 area when applying this exception. One must consider only that floor area, directly adjacent to the building entrance door, which is completely bounded by walls, doors of any kind, or moveable partitions. The added language is intended to ensure that a door or partition bounding the space directly adjacent to the building entrance door must be self-closing. If not, then the additional floor area beyond that door or partition can become part of the "3000 ft2" area that still requires the installation of a vestibule at the building entrance.

Final Action: AS AM AMPC____ D

EC133-07/08
Table 503.2.8

Proposed Change as Submitted:

Proponent: Charles Cottrell, North American Insulation Manufacturers Association (NAIMA)

Revise table as follows:

TABLE 503.2.8
MINIMUM PIPE INSULATION
(thickness in inches)

FLUID	NOMINAL PIPE DIAMETER	
	≤1.5"	>1.5"
Steam	1 ½	3
Hot Water	~~1~~ <u>1 1/2</u>	~~2~~ <u>2 ½</u>
Chilled water, brine or refrigerant	~~1~~ <u>2 ½</u>	~~1 ½~~ <u>3</u>

(Footnotes not shown remain unchanged)

Reason: The pipe insulation requirements for commercial buildings currently in the IECC should be increased due to the recent increases in energy prices. The thicknesses currently in the code are based on economic evaluations for buildings that are operated at a lower number of hours than many buildings built using the IECC.

Cost Impact: The code change proposal will increase the cost of construction. The cost of this change will be less than the energy savings and have a net positive cash flow.

Committee Action: **Approved as Modified**

Modify proposal as follows:

TABLE 503.2.8
MINIMUM PIPE INSULATION
(thickness in inches)

FLUID	NOMINAL PIPE DIAMETER	
	≤1.5”	**>1.5”**
Steam	1 ½	3
Hot Water	1 1/2	~~2 ½~~ 2
Chilled water, brine or refrigerant	~~2 ½~~ 1 1/2	~~3~~ 1 1/2

a. (No change to current text)
b. For insulation with a thermal conductivity not equal to 0.27 Btu • inch/h • ft^2 • °F at a mean temperature of 75°F, the minimum required pipe thickness is adjusted using the following equation;

$T = r[(1+t/r)^{K/k}-1]$

Where: T = Adjusted insulation thickness (in)

r=actual pipe radius (in)
t=insulation thickness from applicable cell in table (in)
K=New thermal conductivity at 75°F (Btu•in/hr•ft^2•°F)
k=0.27 Btu•in/hr•ft^2•°F

Committee Reason: The proposal for increased insulation on hot water supply will provide an opportunity for significant energy efficiency gains at a relatively low cost. The modification proposed by the proponent called for smaller increases on chilled water pipe, as it was seen that the originally proposed thickness insulation values were not cost effective.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Steven J. Clark, P.E., Aquatherm, Inc., representing himself, requests Disapproval.

Commenter's Reason: The proposed modification increases the insulation level for .5 to 1.5 inch pipe to 1.5 inches thick. This is three times the thickness required by ASHRAE 90.1. Due to pipe geometry, this results in up to six times the physical quantity of insulation material required per foot of pipe. Energy savings are minimal, so the payback for the incremental insulation levels will be well beyond the life of the building.

In addition, the resulting size of the insulated pipe makes it so they no longer fit in standard construction. For example, a 1 inch pipe with 1.5” of insulation now has on OD of 4’. Standard interior framed walls have only 3.5” of clear space inside. This code change means that pipes will no longer fit inside of standard walls, substantially impacting costs.

Worse still is the proposed code would increase costs of energy efficient hydronic systems, driving designs to other less efficient systems.

Public Comment 2:

Michael J. Resetar, Armacell LLC, and Roger Schmidt, K Flex USA, request Disapproval.

Commenter's Reason: [1]The current standard is already in excess of the ASHRAE 90.1 insulation thickness table.

With regard to the chilled water ≤ 1.5” pipe the current thickness 1” has an efficiency of 75% and the proposed thickness of 1-1/2” has an efficiency 78% only a 3% improvement over the 1” thickness.

[2]With regard to the Hot water and the ≤ 1-1/2” pipe the current 1” thickness has an efficiency of 75% and the proposed thickness of 1-1/2” has an efficiency of 80%, only a 5% improvement over the 1” thickness>

[2]As shown in the Armacell LLC calculations the overwhelming portion of the energy savings is coming form the first 1” of insulation thickness and very little energy savings from the additional ½” thickness.

Cost of the thicker insulation is minimum of 1-1/2” with the efficiency improvement only 3%

The thicker insulation will put additional fuel load in the building.

In many cases the wall thickness will need to be increased to accommodate the thicker insulation.

We agree there will be an increase in cost of construction, but we do not agree the cost is less than the energy savings.

Our recommendation is to leave the 503.2.8 insulation thickness as is with out the increase in wall thickness for the smaller piping.

Bibliography:

[1] ASHRAE 90 Table 6.8.3, Minimum Pipe Insulation Thickness; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; Atlanta, GA.

[2] Armacell LLC Report; Armacell LLC; Mebane, NC.

Final Action: AS AM AMPC____ D

EC134-07/08

503.2.9, 503.2.9.1, 503.2.9.1.1 (New), 503.2.9.1.2 (New), 503.2.9.1.3 (New), 503.2.9.1.4 (New), 503.2.9.2, 503.2.9.3, 503.2.9.3.1 (New), 503.2.9.3.2 (New), 503.2.9.3.3 (New), 503.2.9.3.4 (New)

Proposed Change as Submitted:

Proponent: John Neff, Washington State Building Code Council

Delete and substitute as follows:

~~**503.2.9 HVAC system completion.** Prior to the issuance of a certificate of occupancy, the design professional shall provide evidence of system completion in accordance with Sections 503.2.9.1 through 503.2.9.3.~~

~~**503.2.9.1 (Supp) Air system balancing.** Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger.~~

~~**503.2.9.2 Hydronic system balancing.** Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections.~~

~~**503.2.9.3 Manuals.** The construction documents shall require that an operating and maintenance manual be provided to the building owner by the mechanical contractor. The manual shall include, at least, the following:~~

1. ~~Equipment capacity (input and output) and required maintenance actions.~~
2. ~~Equipment operation and maintenance manuals.~~
3. ~~HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field determined setpoints shall be permanently recorded on control drawings, at control devices or, for digital control systems, in programming comments.~~
4. ~~A complete written narrative of how each system is intended to operate.~~

503.2.9 Mechanical systems commissioning and completion requirements.

503.2.9.1 System commissioning. Commissioning is a process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner's project requirements and construction documents. Drawing notes shall require commissioning and completion requirements in accordance with this section. Drawing notes may refer to specifications for further requirements. Copies of all documentation shall be given to the owner.

503.2.9.1.1 Commissioning plan. A commissioning plan shall include as a minimum the following items:

1. A detailed explanation of the original owner's project requirements,
2. A narrative describing the activities that will be accomplished during each phase of commissioning, including guidance on who accomplishes the activities and how they are completed,
3. Equipment and systems to be tested, including the extent of tests,
4. Functions to be tested (for example calibration, economizer control, etc.),
5. Conditions under which the test shall be performed (for example winter and summer design conditions, full outside air, etc.), and
6. Measurable criteria for acceptable performance.

503.2.9.1.2 Systems adjusting and balancing. All HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates. Test and balance activities shall include as a minimum the following items:

1. Air systems balancing: Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp

(18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.

Exception: Fan with fan motors of 1 hp or less.

2. Hydronic systems balancing: Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

Exceptions:

1. Pumps with pump motors of 5 hp or less.
2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.

503.2.9.1.3 Functional performance testing,

503.2.9.1.3.1 Equipment functional performance testing. Equipment functional performance testing shall demonstrate the correct installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications. This demonstration is to prove the operation, function, and maintenance serviceability for each of the Commissioned systems. Testing shall include all modes of operation, including:

1. All modes as described in the Sequence of Operation,
2. Redundant or automatic back-up mode,
3. Performance of alarms, and
4. Mode of operation upon a loss of power and restored power.

Exception: Unitary or packaged HVAC equipment listed in Tables 503.2.3 (1) through (3) that do not require supply air economizers.

503.2.9.1.3.2 Controls functional performance testing. HVAC control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.

503.2.9.1.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and provided to the Owner. The report shall be identified as "Preliminary Commissioning Report" and shall identify:

1. Itemization of deficiencies found during testing required by this section which have not been corrected at the time of report preparation and the anticipated date of correction.
2. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.
3. Climatic conditions required for performance of the deferred tests, and the anticipated date of each deferred test.

503.2.9.2 Acceptance. Buildings, or portions thereof, required by this code to comply with this section shall not be issued a final certificate of occupancy allowing public or owner occupation until such time that the building official has received a letter of transmittal from the building owner that stats they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the building official, a copy of the Preliminary Commissioning Report shall be made available for review.

503.2.9.3 Completion requirements. The construction documents shall require that within 90 days after the date of final certificate of occupancy, the documents described in this section be provided to the building owner.

503.2.9.3.1 Drawings. Construction documents shall include as a minimum the location and performance data on each piece of equipment.

503.2.9.3.2 Manuals. An operating manual and a maintenance manual shall be in accordance with industry-accepted standards and shall include, at a minimum, the following:

1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
2. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
3. Names and addresses of at least one *service agency*.
4. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
5. A complete narrative of how each system is intended to operate, including suggested setpoints.

503.2.9.3.3 System balancing report. A written report describing the activities and measurements completed in accordance with Section 503.2.9.1.2

503.2.9.3.4 Final Commissioning Report. A complete report of test procedures and results identified as "Final Commissioning Report" shall include:

1. Results of all Functional Performance Tests.
2. Disposition of all deficiencies found during testing, including details of corrective measures used or proposed.
3. All Functional Performance Test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

   Exception: Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.

Reason: The purpose of this code change proposal is to provide expanded direction on commissioning requirements.

Building commissioning requirements have been in place in Washington since 2000. Also, 2005 Title 24 (California's energy code) requires commissioning functional and performance testing. Commissioning is an important means of ensuring systems are installed and function as designed. Far too many buildings contain substantive defects and programming errors that impact the performance and functionality of the building. Commissioning is a means of discovering and correcting these defects. Commissioning also provides documentation of system design intent and operating sequences, and documents that building staff receive accurate operation manuals and drawings.

The cost of commissioning is a small part of the overall project, yet can provide substantial payback in the form of reduce energy usage, better building performance, improved air quality, and higher productivity. A 2004 study by Lawrence Berkeley National Laboratory concluded that commissioning is cost-effective for both new and existing buildings of a variety of uses and sizes, not only in energy savings but also in extended equipment lifetimes and lower maintenance costs. Investigators found that the median payback of building commissioning was 4.8 years, and when non-energy impacts were factored in, the payback was considerably reduced.

Bibliography:
Lawrence Berkeley National Laboratory Report Number 56637, The Cost-Effectiveness of Commercial-Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Building and New Construction in the United States, December 2004, http://eetd.lbl.gov/Emills/PUBS/Cx-Costs-Benefits.html

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: **Approved as Submitted**

Committee Reason: The proposal expands the requirements for HVAC equipment commissioning to greater detail and more succinct information than is presently in the code. This will make the process easier to understand and regulate, thus insuring that proper commissioning is performed.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Joseph Hill, NY State Department of State, representing the Codes Division, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

503.2.9 Mechanical systems commissioning and completion requirements.

<u>**Exception:** Commercial buildings where 5,000 square feet or less of work area is involved are exempt from the following Sections: 503.2.9.1, 503.2.9.1.1, 503.2.9.1.3, 503.2.9.1.3.1, 503.2.9.1.4, 503.2.9.2, and 503.2.9.3.4</u>

503.2.9.2 Acceptance. Buildings, or portions thereof, required by this code to comply with this section shall not be issued a final certificate of occupancy ~~allowing public or owner occupation~~ until such time that the building official has received a letter of transmittal from the building owner that ~~stats~~ <u>states</u> they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the building official, a copy of the Preliminary Commissioning Report shall be made available for review.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: The original proposal as submitted is seen as problematic for two reasons;

1. The proposal applies Building Commissioning to <u>all</u> commercial building, regardless of building size, which will include very small commercial occupancies.
2. The proposal prohibits occupancy of the building pending receipt by the owner of the Preliminary Commissioning report. The wording of the code section indicates that Code Enforcement Official may not allow the building to be occupied unless the Preliminary Commissioning Report has been received by the building owner.

Building Commissioning, when made applicable to <u>all</u> commercial buildings (regardless of the building area) adds a burden of cost to very small commercial buildings. Regardless of the potential energy cost savings, there is a substantial up front cost when building commissioning is involved, and more so when imposed on small buildings. *Building Commissioning* by definition involves an additional layer of professional design services which follows the building from initial design through building completion and sometimes beyond completion. This is onerous on small Commercial buildings, especially those with simple HVAC systems. The energy benefit to a small building, comparative to the cost of commissioning is anticipated to be non- cost effective. As background, LEED 2.2 NC indicates the requirement for qualified building commissioning agents for buildings of 50,000 sq. ft. and greater, and that the design professional be allowed to perform Building Commissioning for building less than 50,000 square feet. More applicably, the ASHRAE 189 draft indicates that Building Project Commissioning **is** required for buildings that exceed 5,000 sq.ft. of gross floor area. Similarly, the *State of Washington Administrative Code* requires building commissioning for School Buildings of 5,000 sq. ft. and greater. The 5,000 sq. ft. building area seems to cross a reasonable threshold for exemption of building commissioning and the cost associated with the procedure.

This public comment would re establish HVAC system completion and balancing for Small Commercial buildings, under 5,000 square feet in area, and removing the Commissioning requirement for Commercial Buildings under 5,000 square feet.

This public comment removes language which requires the Code Enforcement Official to prevent building occupancy in cases where the Preliminary Building Commissioning Report has not been completed.

Public Comment 2:

Tom Scarola, Tishman Speyer, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

503.2.9.2 Acceptance. Buildings, or portions thereof, required by this code to comply with this section shall not be issued a final certificate of occupancy ~~allowing public or owner occupation~~ until such time that the building official has received a letter of transmittal from the building owner that ~~stats~~ <u>states</u> they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the building official, a copy of the Preliminary Commissioning Report shall be made available for review.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: In the real estate development industry of New York City, it is often imperative that a building be occupied according to schedule, assuming of course the building is safe and operational as defined by the applicable codes that lead to a temporary certificate of occupancy. It is often the case that a building can be operational for the purposes of occupancy, but not yet operating per design intent. In fact, in New York City high-rise and high-performance buildings it is often not even possible to achieve design intent at initial occupancy for any number of reasons including but not limited to partial occupancy and in-progress system installation.

Considering the purpose of commissioning as defined by any number of industry standards (i.e. BCA, ASHRAE 189, USGBC, etc) is to verify building operation as per the design intent it would seem impractical and sometimes impossible to delay occupancy for a Commissioning Report as defined in 503.2.9.1.4 (requiring the completion and report of all functional performance tests not deferred by climatic conditions).

The intent of this proposed modification is to mandate the completion and delivery of a Commissioning Report as a prerequisite for a final certificate of occupancy rather than for public or owner occupation.

Public Comment 3:

Deborah F. Taylor, New York City Department of Buildings, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

~~**503.2.9 Mechanical systems commissioning and completion requirements.**~~

~~**503.2.9.1 System commissioning.** Commissioning is a process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner's project requirements and construction documents. Drawing notes shall require commissioning and completion requirements in accordance with this section. Drawing notes may refer to specifications for further requirements. Copies of all documentation shall be given to the owner.~~

~~**503.2.9.2 Acceptance.** Buildings, or portions thereof, required by this code to comply with this section shall not be issued a final certificate of occupancy allowing public or owner occupation until such time that the building official has received a letter of transmittal from the building owner that stats they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the building official, a copy of the Preliminary Commissioning Report shall be made available for review.~~

~~**503.2.9.3 Completion requirements.** The construction documents shall require that within 90 days after the date of final certificate of occupancy, the documents described in this section be provided to the building owner.~~

503.2.9 HVAC system completion for buildings of 50,000 gross square feet or less. Prior to the issuance of a certificate of occupancy, the design professional shall provide evidence of system completion in accordance with Sections 503.2.9.1 through 503.2.9.3.

503.2.9.1 Air system balancing. Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger.

503.2.9.2 Hydronic system balancing. Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections.

503.2.9.3 Manuals. The construction documents shall require that an operating and maintenance manual be provided to the building owner by the mechanical contractor. The manual shall include, at least, the following:

1. Equipment capacity (input and output) and required maintenance actions.
2. Equipment operation and maintenance manuals.
3. HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field determined setpoints shall be permanently recorded on control drawings, at control devices or, for digital control systems, in programming comments.
4. A complete written narrative of how each system is intended to operate.

503.2.~~9~~10 Mechanical systems commissioning and completion requirements for new construction or work areas greater than 50,000 gross square feet.

503.2.~~9~~10.1 System commissioning. Commissioning is a process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner's project requirements and construction documents. Drawing notes shall require commissioning and completion requirements in accordance with this section. Drawing notes may refer to specifications for further requirements. Copies of all documentation shall be given to the owner and shall be made available to the code official for a period of six years following the final certificate of occupancy or project sign-off.

503.2.9.2 Acceptance. Buildings, or portions thereof, required by this code to comply with this section shall not be issued a final certificate of occupancy ~~allowing public or owner occupation~~ until such time that the building official has received a letter of transmittal from the building owner that ~~stats~~ states they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the building official, a copy of the Preliminary Commissioning Report shall be made available for review.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: Distinguishes between larger projects that can more easily afford commissioning and smaller projects that cannot, while requiring the testing for smaller projects as well.

Makes all related documentation available to the code official, even that which is not submitted.

Public Comment 4:

Donald J. Winston, PE, The Durst Organization, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

503.2.9.1.2 Systems adjusting and balancing. All HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within ~~10% of design rates~~ the tolerances provided in the project specifications. Test and balance activities shall include as a minimum the following items:

1. Air systems balancing: Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.

   Exception: Fan with fan motors of 1 hp or less.

2. Hydronic systems balancing: Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

   Exceptions:

   1. Pumps with pump motors of 5 hp or less.
   2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: The tolerances for system balancing varies by project based a multitude of factors including but not limited to system type, criticality, sensitivity, and diversity. The design team should indicate the necessary tolerances specific to the project and owner requirements as part of the specifications; a general statement stipulating a 10% tolerance for all systems could weaken those project specific tolerances developed by the design team.

Public Comment 5:

Donald J. Winston, PE, The Durst Organization, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

503.2.9.1.2 Systems adjusting and balancing. All HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates. Test and balance activities shall include as a minimum the following items:

1. Air systems balancing: Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.

    Exception: Fan with fan motors of 1 hp or less.

2. Hydronic systems balancing: Individual hydronic heating and cooling coils shall be equipped with means for balancing and ~~pressure test connections~~ <u>measuring flow</u>. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

    Exceptions:

    1. Pumps with pump motors of 5 hp or less.
    2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: There are multiple means by which to hydronically balance coils and it is some building owner's preference to measure flow directly as a means of balancing hydronic systems rather than installing pressure test connections. This proposed modification would allow for direct flow measurement to meet the code requirements for hydronic balancing of coils.

Public Comment 6:

Donald J. Winston, PE, The Durst Organization, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

503.2.9.1.3.2 Controls functional performance testing. HVAC control systems shall be tested to document ~~that~~ <u>whether</u> control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document <u>whether</u> they operate in accordance with approved plans and specifications. <u>Recommendations for corrective work related to HVAC control systems testing and sequences of operation functional testing shall be issued to the owner.</u>

(Portions of proposal not shown remain unchanged)

Commenter's Reason: The intent of this proposed modification is to better align responsibility with the installing contractor rather than transferring it to the commissioning entity.

Public Comment 7:

Donald J. Winston, PE, The Durst Organization, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

503.2.9.1.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and provided to the Owner. The report shall be identified as "Preliminary Commissioning Report" and shall identify:

1. Itemization of deficiencies found during testing required by this section which have not been corrected at the time of report preparation ~~and the anticipated date of correction~~.
2. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.
3. Climatic conditions required for performance of the deferred tests~~, and the anticipated date of each deferred test~~.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: The intent of this proposed modification is to better align responsibility with the installing contractor and construction management team rather than transferring it to the commissioning entity. In other words, for a commissioning entity to anticipate a date of correction would assume the responsibility of the construction management team in determining project schedule and the installing contractor to remediate the deficiency "on-time" and "the first-time". In the same way, specifying an anticipated date for a test deferred due to climate is also assuming responsibility based on the predictability of climate; indicating the climatic conditions necessary to conduct deferred tests should itself be sufficient to meet the intent of this section.

Public Comment 8:

Donald J. Winston, PE, The Durst Organization, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

503.2.9.2 Acceptance. Buildings, or portions thereof, required by this code to comply with this section shall not be issued a final certificate of occupancy ~~allowing public or owner occupation~~ until such time that the building official has received a letter of transmittal from the building owner that ~~stats~~ states they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the building official, a copy of the Preliminary Commissioning Report shall be made available for review.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: In the real estate development industry of New York City, it is often imperative that a building be occupied according to schedule, assuming of course the building is safe and operational as defined by the applicable safety codes that lead to a temporary certificate of occupancy. It is often the case that a building can be operational for the purposes of beneficial occupancy, but not yet operating per design intent. In fact, in New York City high-rise (20-100 stories) and high-performance buildings it is often not even possible to achieve design intent at initial occupancy for any number of reasons including but not limited to partial occupancy of e.g. lower floors and in-progress system installation.

Considering the purpose of commissioning as defined by any number of industry standards (i.e. BCA, ASHRAE 189, USGBC, ASHRAE 0-2005, etc) is to verify building operation as per the design intent it would seem impractical and sometimes impossible to delay occupancy for a Commissioning Report as defined in 503.2.9.1.4 (requiring the completion and report of all functional performance tests not deferred by climatic conditions).

The intent of this proposed modification is to mandate the completion and delivery of a Commissioning Report as a prerequisite for a final certificate of occupancy rather than for public or owner occupation.

Public Comment 9:

John Michael Clift, King George County, VA, representing VPMIA/VBCOA, requests Disapproval.

Commenter's Reason: The proposed change has requirements to be performed after the Certificate of Occupancy is issued. The construction code is only applicable until the Certificate of Occupancy is issued. After that the Fire Code and Property Maintenance Codes are applicable. The proposed change requires the building owner to submit a letter to the Code Official to allow the Certificate of Occupancy to be issued. This letter is to state the owner has received a preliminary report. There is no requirement for anyone to verify the report is done correctly. Balancing of a system is an ongoing event for the life of the building.

Public Comment 10:

Guy McMann, Jefferson County, CO, representing the Colorado Association of Plumbing and Mechanical Officials (CAPMO), requests Disapproval.

Commenter's Reason: The focus of what the energy code is supposed to accomplish is becoming lost. It should be a practical document that is understandable and user friendly. Proposals like this deviate from that fundamental principal. This proposal is unrealistic in its demands and as a result, unenforceable. Why should it be the Building Officials responsibility to see to it that contractors furnish building owners with documentation as to the operation of building mechanical systems after a C.O. has been issued? This has always been handled between owners and contractors. The owner has a right to get what they paid for and the free market system takes care of that all by itself without the Building Official acting as an intermediary. This is clearly a maintenance issue, not a code / life-safety issue. This text requires the Building Official to verify the detailed technical aspects of the buildings mechanical systems that generally only the contractor would be fully aware of. Why have all these technical requirements in a code that will not be witnessed or verified in any respect by the mechanical inspector, who is generally responsible for this type of verification. Certainly more staff would be required to effectively enforce these requirements not to mention the added cost of the labor involved in testing and so forth. Is it realistic to believe a Building Official should with-hold a C.O. due to a report not furnished to a building owner by a contractor? Where is the line to be drawn? The duties of the Building Official are burdensome enough without having to juggle these types of unrealistic dictates.

What is "commissioning" and how far does it go? There is no definition. This change requires actions within 90 days after receiving a CO but what happens if said activities are not completed? Is the Building Official to forcibly revoke occupancy because the owner did not receive paperwork from contractors? Exactly what is a narrative and how does one conclude that such narratives are complete and accurate? Should a set of plans be rejected as a result of incomplete narratives? Are inspectors to verify design flow rates? There is obviously more questions than answers. What's the point in requiring any of this if it's not verifiable? The "Equipment and controls functional performance test" is strictly a maintenance issue and it is unlikely that a plans examiner or inspector can verify that what's on the job and what's on the plans is functional and operating according to design. This is where the design professional enters the picture. The concept of building commissioning is acceptable but this proposal goes too far and should be disapproved. EC-135 achieves the same basic principal with much less confusion.

Public Comment 11:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: Completely rewrites the provisions for the installation of HVAC equipment and systems. Requires Air system balancing and compliance with certain Manuals; The proponent added the following text: Mechanical systems commissioning and completion requirements; System commissioning; Commissioning plan; System adjusting and balancing; Functional performance testing; Equipment performance testing; Controls functional performance testing; Preliminary commissioning report; Acceptance; Completion requirements; Drawings; System balancing reports, and a Final commissioning report.

These requirement are normally found written into the Architect's Specifications portion of the design documents and does not need to be a code issue. These items are performance issues and have nothing to do with the life Health and safety of individuals within the building, only their comfort. By requiring these items, where is the money going to come from to pay for all of these tests? What is the code official going to do with all this information and how would the code official check these requirements? This proposal is changing the IECC to shore-up the growth industry of the building rating associations and taking the responsibility away from the code official.

Final Action: AS AM AMPC____ D

EC137-07/08

503.2.10 (New)

Proposed Change as Submitted:

Proponent: Chuck Murray, Washington State University Extension Energy Program, representing Northwest Energy Code Group

Add new text as follows:

503.2.10 Heating systems outside a building. Heating systems installed outside a building shall be radiant systems. Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically de-energized when no occupants are present.

Reason: Heating of outdoor spaces has become much more common as smoking bans within buildings have proliferated. Convective heating systems work by heating air and are ineffective and wasteful for outdoor applications. The warm air simply dissipates. Radiant systems provide comfort by warming stationary surfaces and bodies and are more suitable for this application. The requirement for an occupancy sensor or timer switch ensures that these systems will only operate when they are needed to warm occupants.

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: **Approved as Modified**

Modify the proposal as follows:

503.2.10 Heating ~~systems~~ outside a building. ~~Heating~~ systems installed to provide heat outside a building shall be radiant systems. Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically de-energized when no occupants are present.

Committee Reason: This proposal will help prevent the use of wasteful, inappropriate systems on the outside. The modification was editorial to make the requirements more succinctly stated.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The proposal is written to address ANY heating system outside a building. Is this to include pool heaters, snow melt systems? The proposal is poorly written and should be disapproved.

Final Action: AS AM AMPC____ D

EC140-07/08
202, 505.1

Proposed Change as Submitted:

Proponent: Chuck Murray, Washington State University Extension Energy Program, representing Northwest Energy Code Group

1. Delete definition and substitute as follows:

SECTION 202
GENERAL DEFINITIONS

~~**HIGH-EFFICACY LUMINAIRE (Supp).** A lighting fixture that does not contain a medium screw base socket (E24/E26) and whose lamps have a minimum efficacy of:~~

1. ~~60 lumens per watt for lamps over 40 watts,~~
2. ~~50 lumens per watt for lamps over 15 watts to 40 watts,~~
3. ~~40 lumens per watt for lamps 15 watts or less.~~

<u>**HIGH-EFFICACY LAMPS**: Compact florescent lamps, T-8 or smaller diameter linear florescent lamps, or lamps with a minimum efficacy of:</u>

1. <u>60 lumens per watt for lamps over 40 watts,</u>
2. <u>50 lumens per watt for lamps over 15 watts to 40 watts,</u>
3. <u>40 lumens per watt for lamps 15 watts or less.</u>

2. Revise as follows:

505.1 General. (Mandatory). This section covers lighting system controls, the connection of ballasts, the maximum lighting power for interior applications, and minimum acceptable lighting equipment for exterior applications.

> **Exception:** Lighting within dwelling units <u>where 50 percent or more of the permanently installed interior light fixtures are fitted with high-efficacy lamps</u>.

Reason: Incandescent lighting represents 10% of residential energy use yet has no code requirements, despite the now wide-spread availability of compact fluorescent lamps (CFLs), a cost-effective, much more efficient alternative. Consumer awareness and acceptance of CFLs has risen dramatically in the past few years. Replacements for almost all styles of incandescent lamps are now available.

Replacing a single 100-watt incandescent that is turned on 3 hours per day with a 25-watt CFL reduces energy use by 82 kWh per year. At 8¢/kWh, annual savings to the homeowner is $6.57 per year -- from one bulb that costs two dollars! Tenants benefit even more because CFLs last five or more times longer than incandescents. CFLs can therefore pay for themselves based solely on the reduced replacement of bulbs. Initial costs of installing CFLs are paid back in a matter of months.

The average new apartment has 31 sockets. Replacing 50% (16) incandescents with CFLs at an average incremental cost of $2 would increase the cost of construction of a new apartment by $32.

Cost Impact: The code change proposal will increase the cost of construction.

Committee Action: **Approved as Submitted**

Committee Reason: Consistent with previous action on Chapter 4, the committee believes that high efficiency lamps are readily available and costs are such that the use of them are affordable and cost effective.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Jason Groob, Horton Lees Brogden Lighting Design, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

<u>**HIGH-EFFICACY LUMINAIRE (Supp).** A lighting fixture that does not contain a medium screw base socket (E24/E26) and whose lamps have a minimum efficacy of:</u>

1. <u>60 lumens per watt for lamps over 40 watts,</u>
2. <u>50 lumens per watt for lamps over 15 watts to 40 watts,</u>
3. <u>40 lumens per watt for lamps over 5 watts to 15 watts,</u>
4. <u>30 lumens per watt for lamps 5 watts or less.</u>

HIGH-EFFICACY LAMPS: Compact florescent lamps, T-8 or smaller diameter linear florescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts,
2. 50 lumens per watt for lamps over 15 watts to 40 watts,

~~3. 40 lumens per watt for lamps 15 watts or less.~~

3. <u>40 lumens per watt for lamps over 5 watts to 15 watts,</u>
4. <u>30 lumens per watt for lamps 5 watts or less.</u>

(Portions of proposal not shown remain unchanged)

Commenter's Reason: This alteration to the proposed text brings the IECC requirements into alignment with the California Title-24 2008 requirements. The addition of a lower category of wattage allows for the use of long-life xenon or other low-wattage lamps, and allows lighting designers the freedom to use low-wattage lighting to provide the most energy-effective design. This provision also allows for many LED products that are currently available in the marketplace to meet the requirements of the high-efficacy definition.

Public Comment 2:

James R. Benya, PE, FIESNA, FIALD, LC, Benya Lighting Design, requests Disapproval.

Commenter's Reason: This is redundant language proposed for N1104 and therefore not appropriate or needed here. If there is a reason to put in both places, a reference would be a better mechanism to ensure that future code revisions do not create conflicts.

The committee reasons should be challenged. The average annual use of residential lighting is 750 hours per lamp.[1] The annual savings reaped by replacing a single 100 watt "A" lamp with a 26 watt CFL (roughly equal initial lumens) saves 55.5 kWh which at $.08 = $4.44 per year, a very acceptable payback as long as a dimming lamp is not required. A dimming lamp can easily cost $15-$18.

[1] Ecos Consulting, Residential Lighting Program for the Northwest Energy Efficiency Alliance, 2002, Benya Lighting Design report on annual residential energy use including additional references.

Public Comment 3:

Bob Croft, Pikes Peak Regional Building Department, representing the Colorado Chapter of ICC, requests Disapproval.

Commenter's Reason: The proposed code change goes beyond the scope of Section 101.3, which in part states "**101.3 Intent.** This code shall regulate the **design and construction of <u>buildings</u>** for the effective use of energy".

Light bulbs are no more required at a final inspection than shades on a window, while both conserve energy, they are impractical to enforce as a building department.

Public Comment 4:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The proponent gives reasons for the change in 505.1 that incandescent lighting accounts for 10% of residential energy use. Residential dwelling units are not covered under Chapter 5 (see 501.1 Scope). They are covered under Chapter 4. There is an error here. With the newly enacted Federal Mandate to cease production of incandescent light bulbs, is this proposal really needed? Consumers are already replacing their incandescent lights voluntarily for CFL's and the need for this proposal is not required .

Final Action: AS AM AMPC____ D

EC144-07/08
505.5.1.4

Proposed Change as Submitted:

Proponent: Steve Ferguson, American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)

Revise as follows:

505.5.1.4 Line-voltage lighting track and plug-in busway. <u>The wattage shall be;</u>

1. The specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft. (98 W/lin. m), or
2. The wattage limit of the system's circuit breaker, or
3. The wattage limit of other permanent current limiting device(s) on the system.

~~The wattage shall be the greater of the wattage of the luminaires determined in accordance with Sections 505.5.1.1 through 505.5.1.3 or 30 W/linear foot (98W/lin m).~~

Reason: The proposed changes come from ANSI/ASHRAE/IESNA Standard 90.1-2007. This allows a user to calculate wattage for track lighting based on the maximum wattage that is possible to apply to a section of track instead of a potentially arbitrary value that may be higher than physically possible in the application. This inclusion in IECC will make IECC more in line with practical code application and make it more effective and therefore more readily applied.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: **Approved as Submitted**

Committee Reason: This is a practical and reasonable method for calculation of wattage on track lighting that is consistent with ASHRAE and is more in line with practical code application.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

James R. Benya, PE, FIESNA, FIALD, LC, Benya Lighting Design, requests Approval as Modified by this Public Comment.

Replace proposal with the following:

505.5.1.4 Line-voltage lighting track and plug-in busway rated < 20 amps. The wattage of line-voltage lighting track and plug-in busway rated 20 amps or less per circuit shall be either:

1. The volt-ampere rating of the branch circuit feeding the luminaires; or
2. The higher of the volt ampere rating of a current limiter either integral to the track or busway or a contained in a track lighting supplementary overcurrent protection panel controlling the luminaires or 12.5 Watts per linear foot (41 w/lin.m.) of track or busway; or
3. The higher of the maximum relamping rated wattage of all of the luminaires included in the system, or 30 Watts per linear foot (98 w/lin.m) or track or busway. The maximum relamping rated watts shall be determined according to each luminaire's permanent factory-installed label, as specified by UL 1574.

If under option (2) a track lighting supplementary overcurrent protection panel is employed, then it shall meet the following conditions:

1. Be listed for the use; and,
2. Be used only with line voltage track lighting; and
3. Be permanently installed in an electrical equipment room, or permanently installed adjacent to the lighting panel board providing overcurrent protection for the track lighting circuits served by the supplementary over current protection panel; and
4. Be prominently labeled "NOTICE: This Panel for Track Lighting Energy Code Compliance Only. The overcurrent protection devices in this panel shall only be replaced with the same or lower amperage. No other overcurrent protective device shall be added to this panel. Adding to, or replacement of existing overcurrent protective device(s) with higher continuous ampere rating, will void the panel listing and require re-submittal and re-certification of energy code compliance.

505.5.1.5 Line-voltage lighting track and plug-in busway rated > 20 amps. The wattage of line voltage busway or track rated for more than 20 amperes shall be the total volt-ampere rating of the branch circuit feeding the busway or track.

Commenter Reason: The proposed revisions take advantage of California Title 24 2008. While minor they address deficiencies and oversights in the 90.1 Language from lessons learned in California enforcement. Cheating and gaming issues discovered under 2005 California Title 24 from which ASHRAE/IESNA 90.1-2007 was taken are hereby incorporated.

Bibliography
California Energy Commission CEC-400-2008-011

Final Action: AS AM AMPC____ D

EC146-07/08
Table 505.5.2

Proposed Change as Submitted:

Proponent: Steve Ferguson, American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)

Revise table as follows:

TABLE 505.5.2
INTERIOR LIGHTING POWER ALLOWANCES

(No change to table entries)

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.

a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.

b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below ~~1.6 W/ft^2 times the area of the specific display but not to exceed 50% of the floor area, or 3.9 W/ft2 times the actual case or shelf area for displaying and selling jewelry, china or silver,~~ shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = 1000 watts + (Retail Area 1 x 1.0 W/ft2) + (Retail Area 2 x 1.7 W/ft2) + (Retail Area 3 x 2.6 W/ft2) + (Retail Area 4 x 4.2 W/ft2),

where

Retail Area 1	=	the floor area for all products not listed in Retail Area 2, 3 or 4.
Retail Area 2	=	the floor area used for the sale of vehicles, sporting goods and small electronics.
Retail Area 3	=	the floor area used for the sale of furniture, clothing, cosmetics and artwork.
Retail Area 4	=	the floor area used for the sale of jewelry, crystal, and china.

Exception: Other merchandise categories may be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the authority having jurisdiction

Reason: The proposed changes come from ANSI/ASHRAE/IESNA Standard 90.1-2007. This change presents a much more usable set of lighting allowances that eliminate common issues of application of additional power allowances. The proposed set of allowances also further categorizes application types with the effect of reducing energy use by forcing many product types into lower allowance but appropriate categories.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: **Approved as Modified**

Modify the proposal as follows:

TABLE 505.5.2
INTERIOR LIGHTING POWER ALLOWANCES

(No change to table entries)

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.

a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.

b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = 1000 watts + (Retail Area 1 x ~~1.0~~ 0.6 W/ft2) + (Retail Area 2 x ~~1.7~~ 0.6 W/ft2) + (Retail Area 3 x ~~2.6~~ 1.4 W/ft2) + (Retail Area 4 x ~~4.2~~ 2.5 W/ft2).

(Portions of proposal not shown remain unchanged)

Committee Reason: This provides a clear, understandable method for dealing with retail lighting. The modification makes the allowance more restrictive as the committee agreed that the original values were too liberal.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

James R. Benya, PE, FIESNA, FIALD, LC, Benya Lighting Design, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

Additional Interior Lighting Power Allowance = 1000 watts + (Retail Area 1 x ~~0.6~~ 1.0 W/ft^2) + (Retail Area 2 x ~~0.6~~ 1.7 W/ft^2) + (Retail Area 3 x ~~1.4~~ 2.6 W/ft^2) + (Retail Area 4 x ~~2.5~~ 4.2 W/ft^2).

(Portions of proposal not shown remain unchanged)

Commenter's Reason: Proposal EC146-07/08 reduces display lighting allowances for retail lighting to less than ½ of the allowance in ANSI/ASHRAE/IESNA 90.1-2007. The purpose of this comment is to employ the same methodology and values as ANSI/ASHRAE/IESNA 90.1-2007.

We have researched the history behind this change. According to Eric Richman

> *"The current active proposal to IECC with changes to retail numbers is EC 146. It is modifying the "Additional Lighting Power Allowances" with the newly developed ones (already in 90.1-2007) BUT has NOTHING to do with the base retail space LPD. This was originally proposed by ASHRAE but WITH the ASHRAE numbers to make IECC allowances similar to 90.1. However, what happened is that at the same time Chuck Murray had a similar proposal but with different (lower values - EC145). The Ltg Subc was, of course, against EC 145 in favor of EC 146. EC 146 was initially approved on the first round instead of EC 145 (because the EC 146 language is clearer) BUT THE VALUES WERE CHANGED as part of a floor amendment to include the lower values from EC145. The numbers in the original EC 145 were not arbitrary. They were developed in a similar manner to the new 90.1 retail additional allowances (in 90.1-2010) but with one major change - the use of CMH instead of standard efficient MH. The Ltg Subc was initially against this (because it was different than what was in 90.1) but because it was developed with similar process, the SubC is exploring it to see if it has merit i.e. if it is a potentially cost effective change. Initial exploration shows that it IS cost effective but the SubC is looking at multiple mock-ups to be sure. At this point if it does turn out to be cost effective for a variety of applications, then the 90.1 Ltg SubC might consider it as a proposal for 90.1-2010. The bottom line is that the analysis is not done on this yet. We are trying to have something soon enough so that we (90.1 full committee) can lodge a reasonable opinion at the next IECC hearings if we decide it is not a good proposal."*

The same issue was raised in the California Title 24 process. In both Commission Research and public testimony, the high cost of ceramic metal halide was unable to be offset by energy savings in a cost effective manner. Key points include:

a. The cost of ceramic metal halide lamp ranges from about \$25 to \$75. The lower end of the range only applies to certain lamps such as ED-17 and only when purchased in large quantities such as by retail chains. The higher end of the range applies to small quantities and the more expensive lamps such as PAR and MR types.
b. The manufacturing cost of metal halide ballasts, while slightly lower than in prior years, have been offset by inflation and the loss of the dollar's value.
c. The incremental cost of a metal halide luminaire (compared to halogen IR) ranges from \$150 to over \$300 depending on the type of luminaire (recessed, track, etc.) and the purchasing capability of the owner. Chain retailers can obtain luminaires at near wholesale price, but most developers and smaller retailers will often encounter markups on lamps and ballasts of 25-50% over wholesale.
d. Lighting designers doing retail projects in California testified that a reasonable end user cost for a metal halide track luminaire would be at least \$250 in 2007 dollars.
e. Using mean beam candlepower comparisons, the approximate ratio of halogen IR PAR lamps to ceramic metal halide PAR lamps is almost exactly 2:1. Further efficiency advantages may be realized using separate lamp/reflector systems but this also raises the costs of fixtures. Examples: 55 watt Silver IR Halogen 25° flood is 1050 lumens and 4000 cd; 20 watt (25 incl ballast) PAR-20 Ceramic Metal Halide is 1000 lumens and 3750 cd at 25°. The adjustments made by the committee seem to use a different ratio in which metal halide lamps are used to offset too much halogen wattage.
f. The high cost of metal halide lamps offsets any life advantage and in fact increases this aspect of life cycle cost relative to halogen IR.
g. Based on this, simple payback periods the following lamps do **not** demonstrate reasonable payback periods (assuming \$200 incremental cost and 4000 hours per year at \$0.08):

Halogen IR lamp	Ceramic lamp	Watts Saved	Annual energy cost savings	Payback Period
55	20	30	\$12.00	>16 years
90	39	45	\$18.00	>11 years
150	70	70	\$28.00	>7 years

Bibliography
California Energy Commission CEC-400-2008-011
Personal communication to Carol Jones, PNNL, from Eric Richman, PNNL, ASHRAE/IESNA 90.1 Committee

Public Comment 2:

Katherine C. Abernathy LC, IALD, Abernathy Lighting Design, Inc., representing International Association of Lighting Designers, requests Disapproval.

Commenter's Reason: Interior Lighting Power Allowances for Retail with the arbitrary cut by committee should not stand. After investigating where this all comes from it seems that the 40% reduction can be achieved if one and only one technology is employed. This is currently not cost effective for all projects and more research needs to be done by the lighting community before such a code can be put into place.

Public Comment 3:

Hyman Kaplan, Hy-Lite Design, Inc., representing himself, requests Disapproval.

Commenter's Reason: The lighting power allowance is for the sales area only of a retail building and there is not a way to apply a space-by-space value to the rest of the building (toilets, offices, storage, etc). The LPA in IECC is for the whole building. This proposal does not work.

Final Action: AS AM AMPC____ D

EC150-07/08

202 (New), 505.6.3 (New)

Proposed Change as Submitted:

Proponent: Leo Smith, representing the International Dark Sky Association

Add new text as follows:

SECTION 202
GENERAL DEFINITIONS

FULLY SHIELDED. A light fixture constructed, installed, and maintained in such a manner that all light emitted from the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal plane through the fixture's lowest light emitting part.

505.6.3 Shielding of exterior building lighting fixtures. Only fully shielded fixtures shall be permitted unless a lighting plan is submitted showing that the use of alternative fixtures would provide greater energy efficiency than any comparable lighting plan using fully shielded fixtures.

Exceptions:

1. Luminaires with an output of 150 Watts incandescent or less, or the equivalent light output.
2. Luminaires intended to illuminate the façade of buildings or to illuminate other objects including but not limited to flagpoles, landscape and water features, statuary and works of art.
3. Luminaires for historic lighting on the premises of an historic building as defined in the *International Existing Building Code* or within a designated historic district.
4. Outdoor sports facility lighting of the participant sport area.
5. Emergency exit discharge lighting.
6. Low voltage landscape lighting.
7. Sign illumination.
8. Festoon lighting as defined in the NFPA 70.
9. Temporary lighting for emergency, repair, construction, special events or similar activities.

Reason: New Section 505.6.3 - Conserve energy in outdoor lighting by reducing or eliminating glare by adopting a requirement to fully shield outdoor luminaires and add a definition for "Fully Shielded" to the General Definitions.

Unshielded or partially shielded outdoor luminaires cause glare in the eye of the observer. Glare at night diminishes the ability of the eye to see at lower light levels. Unshielded or partially shielded luminaires require higher lighting levels to compensate for the reduced capacity of the human eye to see in glare. Fully shielded luminaires eliminate or substantially reduce glare in the eye of the observer, and with glare eliminated or reduced, the level of illumination needed by the observer to see in dark surrounds can be achieved with lower wattage lamps, fewer fixtures, or both.

All outdoor light that is misdirected to areas outside the intended area for illumination is wasted energy. Fully shielded fixtures direct more of the light at the targeted area, thereby reducing the energy waste that would otherwise occur with unshielded or partially shielded luminaires. Currently the IEEC does not include a requirement for fully shielded luminaires.

Numerous municipalities and several states have adopted outdoor lighting regulations, including shielding requirements, as part of energy conservation. Adding a fully shielded requirement for outdoor lights to the IECC will increase uniformity.

When illuminating dark surrounds, bright glare sources in the periphery reduce contrast visibility because light scattered in the lens obscures the fovea. This reduction in contrast visibility requires an increase level of illumination to compensate for veiling luminance caused by glare.

Connecticut amended the IECC in 2004 with a new section titled Light Pollution Controls. The wording for the current proposed code change is the same language used in the Connecticut amendment (Section 805.6.1 – Page 89 revised 2005) http://www.ct.gov/dps/lib/dps/office_of_state_building_inspector_files/2005_state_building_code.pdf

The ability to see by the illumination of a full moon on a clear night is an example of how lower levels of light allow the human eye to see in dark surrounds once glare has been eliminated or reduced.

The Roadway Lighting Manual (RP-8-00) includes calculations for Small Target Visibility, factoring for glare on target visibility, and showing that by reducing or eliminating glare, visibility can be maintained using lower light levels.

Shielding to reduce glare is also required by the California Energy Commission in Title 24 section on Outdoor Lighting, 6.2.3 http://www.energy.ca.gov/2005publications/CEC-400-2005 006/chapters_4q/6_Outdoor_Lighting_Signs.pdf

LEED certification Green Building Program provides one point to buildings where the exterior lighting is shielded.

The State of New Mexico has incorporated shielding requirements for outdoor lighting as part of the New Mexico Electric Code (section 290.40) under the Night Sky Protection Act.
http://www.conwaygreene.com/nmsu/lpext.dll?f=templates&fn=main-h.htm&2.0

Veiling luminance is the term used in the lighting industry to describe the loss of vision caused by glare. The Illuminating Engineering Society of North America publishes standards on lighting practices that include a calculation for Veiling Luminance, which is used when determining the amount of light required: the greater the veiling luminance caused by glare, the greater the lighting level needed to offset the VL.

By eliminating or reducing glare, contrast visibility is improved, allowing the eye to see better in darkness with lower lighting levels, thereby reducing energy consumption.

Bibliography:
Connecticut State Building Code, 2005 Supplement - Light Pollution Controls, Page 89, Section 805.6.1.

RP-8-00 *Roadway Lighting*, Illuminating Engineering Society, Appendix F, STV Method (Pages 47-53)
http://www.ct.gov/dps/cwp/view.asp?a=2148&Q=305424&PM=1

California Title 24 – Outdoor Lighting – Full cutoff/cutoff shielding requirement, section 6.2.3 New Mexico Statutes, New Mexico Statutes Unannotated, Chapter 74, Article 12.
http://www.energy.ca.gov/2005publications/CEC-400-2005-006/chapters_4q/6_Outdoor_Lighting_Signs.pdf

LEED Certification: SS Credit 8: Light Pollution Reduction https://www.usgbc.org/ShowFile.aspx?DocumentID=1095

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Approved as Modified

Modify the proposal as follows:

FULLY SHIELDED. A light fixture constructed, installed, and maintained in such a manner that all light emitted from the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal plane through the fixture's lowest light emitting part.

SHIELDED: An outdoor lighting fixture that, in its mounted form, emits no more than 2.5% of its direct light above a horizontal plane through the fixture's lowest light-emitting part and no more than 10% of its direct light between 80 and 90 degrees from horizontal.

505.6.3 Shielding of exterior building lighting fixtures. Only fully shielded or shielded fixtures shall be permitted unless a lighting plan is submitted showing that the use of alternative fixtures would provide greater energy efficiency than any comparable lighting plan using fully shielded fixtures.

Exceptions:

1. Luminaires with an output of 150 Watts incandescent or less, or the equivalent light output.
2. Luminaires intended to illuminate the façade of buildings or to illuminate other objects including but not limited to flagpoles, landscape and water features, statuary and works of art.
3. Luminaires for historic lighting on the premises of an historic building as defined in the *International Existing Building Code* or within a designated historic district or decorative styled luminaires on premises where the daytime aesthetics of the luminaire support the architectural theme. Such luminaires shall incorporate superior refractor or internal reflectors to provide improved optical control.
4. Outdoor sports facility lighting of the participant sport area.
5. Emergency exit discharge lighting.
6. Low voltage landscape lighting.
7. Sign illumination.
8. Festoon lighting as defined in the NFPA 70.
9. Temporary lighting for emergency, repair, construction, special events or similar activities.
10. Installations where the safety will be compromised or where installation of fully shielded luminaires increases energy use or cost.

Committee Reason: This is an opportunity to save energy and at the same time reduce light pollution. The modification was to add an important qualification regarding use of shielded fixtures where safety is an issue or where the installation could create more energy loss.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Al Godwin, CBO, City of Fort Worth, TX, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

505.6.3 Shielding of exterior building lighting fixtures. Only fully shielded or shielded fixtures shall be permitted unless a lighting plan is submitted showing that the use of alternative fixtures would provide greater energy efficiency than any comparable lighting plan using fully shielded fixtures.

Exceptions:

1. Luminaires with an output of 150 Watts incandescent or less, or the equivalent light output.
2. Luminaires intended to illuminate the façade of buildings or to illuminate other objects including but not limited to flagpoles, landscape and water features, statuary and works of art.
3. Luminaires for historic lighting on the premises of an historic building as defined in the *International ~~Existing~~ Building Code* or within a designated historic district or decorative styled luminaires on premises where the daytime aesthetics of the luminaire support the architectural theme. Such luminaires shall incorporate superior refractor or internal reflectors to provide improved optical control.
4. Outdoor sports facility lighting of the participant sport area.
5. Emergency exit discharge lighting.
6. Low voltage landscape lighting.
7. Sign illumination.
8. Festoon lighting as defined in the NFPA 70.
9. Temporary lighting for emergency, repair, construction, special events or similar activities.
10. Installations where the safety will be compromised or where installation of fully shielded luminaires increases energy use or cost.

(Portions of proposal not shown remain unchanged)

Commenter's Reason: Historic buildings are also defined in the IBC so why reference the IEBC. Which code has a broader adoption area? Shouldn't we reference the code that has the greater chance of adoption?

Public Comment 2:

Glenn Heinmiller IALD, LC, LEED AP, Lam Partners, Inc., requests Approval as Modified by this Public Comment.

Modify proposal as follows:

FULLY SHIELDED LIGHTING FIXTURE. ~~A light fixture constructed, installed, and maintained in such a manner that all light emitted from the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal plane through the fixture's lowest light emitting part.~~ An outdoor lighting fixture that, in its mounted form, emits no more than 0% of its fixtures lumens above a horizontal plane through the fixture's lowest light-emitting part, and no more than 10% of its fixture lumens in the solid angle from 80 degrees to 90 degrees (horizontal).

SHIELDED LIGHTING FIXTURE: An outdoor lighting fixture that, in its mounted form, emits no more than ~~2.5%~~ 10%of its ~~direct light~~ FIXTURE LUMENS above a horizontal plane through the fixture's lowest light-emitting part and no more than 10% of its fixture lumens in the solid angle ~~direct light between~~ from 80 degrees to ~~and~~ 90 degrees ~~from~~ horizontal.

PARTLY SHEILDED LIGHTING FIXTURE: An outdoor lighting fixture that, in its mounted form, emits no more than 15% of its fixture lumens above a horizontal plane through the fixture's lowest light-emitting part.

505.6.3 Shielding of ~~exterior~~ site and building mounted exterior lighting fixtures. ~~Only fully shielded or shielded fixtures shall be permitted~~
Fixtures with initial lamp lumens greater than 16000 shall be *fully shielded*,
fixtures with initial lamp lumens between 7000 and 16000 shall be *shielded* or *fully shielded*,
fixtures with initial lamp lumens between 1000 and 7000 shall be *partly shielded*, *shielded*, or *fully shielded*;
unless a lighting plan is submitted showing that the use of alternative fixtures would provide greater energy efficiency than any comparable lighting plan using partly shielded, shielded and fully shielded fixtures.

Exceptions:

~~1. Luminaires with an output of 150 Watts incandescent or less, or the equivalent light output.~~

~~2~~ 1. Luminaires intended to illuminate the façade of buildings or to illuminate other objects including but not limited to flagpoles, landscape and water features, statuary and works of art.

~~3~~ 2. Luminaires for historic lighting on the premises of an historic building as defined in the *International Existing Building Code* ~~or within a designated historic district or decorative styled luminaires on premises where the daytime aesthetics of the luminaire support the architectural theme. Such luminaires shall incorporate superior refractor or internal reflectors to provide improved optical control~~.
4 3. Outdoor sports facility lighting of the participant sport area.
~~5~~ 4. Emergency exit discharge lighting.
~~6~~ 5. Low voltage landscape lighting.
~~7~~ 6. Sign illumination.
~~8~~ 7. Festoon lighting as defined in the NFPA 70.
~~9~~ 8. Temporary lighting for emergency, repair, construction, special events or similar activities.
~~10. Installations where the safety will be compromised or where installation of fully shielded luminaires increases energy use or cost.~~

Commenter's Reason: I support the general intent of the proposal to improve outdoor lighting energy efficiency for the reason stated by the proponent, but as written and modified it is not acceptable. The proposal and modifications contain ambiguous language, non-standard technical terms and definitions, and vague, unclear and subjective wording that is unacceptable for code language. The proposed modification is submitted to address the following problems:

The wording in the definitions for *fully shielded* and *shielded* is inconsistent. I propose that the wording for *shielded* as added by the committee be applied to the definition *fully shielded*. I have also added a definition for *partially shielded*, and revised the numeric limit for light above horizontal in the definition for *shielded*. This is explained below.

505.6.3 "Shielding of *exterior building lighting fixtures*". This wording is unclear. This could mean fixtures on the exterior of the building, or fixtures exterior to the building, or building mounted exterior fixtures, or exterior fixtures intended to light the building. I propose "Shielding of site and building mounted exterior lighting fixtures"(assuming that is the intent).

Wording of exception #1 "150 watt incandescent". How much is that? This is not a finite quantity appropriate for code language. I propose deletion of this exception because it is not needed, and would conflict with, the thresholds that are provided in my proposed shielding requirements.

Exception #3 wording – vague/unenforceable. "Decorative styled" is too vague. Just about any fixture could be considered decorative. What are "daytime aesthetics" and how would a code official decide if these "daytime aesthetics" "support the architectural theme"? What is a "superior" refractor? This is not a defined technical term. Superior to what? Why "internal" reflectors? Are external reflectors prohibited? What is "improved" optical control? Improved over what? Who decides what "improved" is? Under my proposed revision for shielding requirements, "decorative" fixtures would be allowed if they were under 1000 lamp lumens, or they met the "partly shielded" or "shielded" definitions and did not exceed the respective lamp lumen limits of 7000 lamp lumens (70-watt HPS or MH equivalent) and 16000 lamp lumens (150-watt HPS or MH equivalent). The percentages of allowed uplight of 15% for *partly shielded* and 10% for *shielded* are based on zonal fixture lumen analysis of various commonly used decorative type fixtures that incorporate some sort of shielding optics.

Delete exception #10 – it is vague and unenforceable. Who decides if "safety will be compromised", and by what criteria? This is a huge loophole as anyone could come up with some reason or claim that their wasteful solution was needed for "safety". This exception is not necessary – "safe" lighting can easily be provided within my proposed requirements.

Public Comment 3:

Matt Latchford LEED AP, Associate IALD, LC, Lam Partners, Inc., requests Approval as Modified by this Public Comment.

Modify proposal as follows:

FULLY SHIELDED LIGHTING FIXTURE: ~~A light fixture constructed, installed, and maintained in such a manner that all light emitted from the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal plane through the fixture's lowest light emitting part.~~ An outdoor lighting fixture that, in its mounted form, emits no more than 0% of its fixtures lumens above a horizontal plane through the fixture's lowest light-emitting part, and no more than 10% of its fixture lumens in the solid angle from 80 degrees to 90 degrees (horizontal).

SHIELDED LIGHTING FIXUTRE: An outdoor lighting fixture that, in its mounted form, emits no more than ~~2.5%~~ 10% of its ~~direct light~~ fixture lumens above a horizontal plane through the fixture's lowest light-emitting part, and no more than 10% of its fixture lumens in the solid angle ~~between~~ from 80 degrees to 90 degrees (horizontal).

PARTLY SHEILDED LIGHTING FIXTURE: An outdoor lighting fixture that, in its mounted form, emits no more than 15% of its fixture lumens above a horizontal plane through the fixture's lowest light-emitting part.

505.6.3 Shielding of ~~exterior~~ site and building mounted exterior lighting fixtures. ~~Only fully shielded or shielded fixtures shall be permitted~~
Fixtures with initial lamp lumens greater than 16000 shall be *fully shielded*,
fixtures with initial lamp lumens between 7000 and 16000 shall be *shielded* or *fully shielded*,
fixtures with initial lamp lumens between 1000 and 7000 shall be *partly shielded*, *shielded*, or *fully shielded*;
unless a lighting plan is submitted showing that the use of alternative fixtures would provide greater energy efficiency than any comparable lighting plan using *partly shielded*, *shielded* and *fully shielded* fixtures.

Exceptions:

~~1. Luminaires with an output of 150 Watts incandescent or less, or the equivalent light output.~~
~~2~~ 1. Luminaires intended to illuminate the façade of buildings or to illuminate other objects including but not limited to flagpoles, landscape and water features, statuary and works of art. The allowable power density for these applications shall be half that listed in Table 505.6.2, with the building façade lighting applying to those items not classified, unless it can be documented that at least 75% of the fixture lumens used to uplight hit a surface.
~~3~~ 2. **Luminaires for historic lighting on the premises of an historic building as defined in the *International Existing Building* ~~*Code*~~** ~~or within a designated historic district or decorative styled luminaires on premises where the daytime aesthetics of the luminaire support the architectural theme. Such luminaires shall incorporate superior refractor or internal reflectors to provide improved optical control.~~

4 3. Outdoor sports facility lighting of the participant sport area.

~~5~~ 4. ~~**Emergency exit discharge lighting.**~~

~~6~~ 5. ~~**Low voltage landscape lighting.**~~

~~7~~ 6. ~~**Sign illumination.**~~ **Self illuminated signage, or signage that it top illuminated.**

~~8~~ 7. Festoon lighting as defined in the NFPA 70.

~~9~~ 8. Temporary lighting for emergency, repair, construction, special events or similar activities.

~~10. Installations where the safety will be compromised or where installation of fully shielded luminaires increases energy use or cost.~~

Commenter's Reason: I support the general intent of the proposal to improve outdoor lighting energy efficiency for the reason stated by the proponent, but as written and modified it is not acceptable. I support the modifications as proposed by Glenn Heinmiller and these comments are in addition to his. In principle, limiting uplight wastes less light and energy and I disagree with several of the exception loopholes for the following reasons. My modifications address the consideration that, if you must uplight, you must do so very efficiently.

The wording in the definitions for *fully shielded* and *shielded* is inconsistent. I propose that the wording for *shielded* as added by the committee be applied to the definition *fully shielded*. I have also added a definition for *partially shielded*, and revised the numeric limit for light above horizontal in the definition for *shielded*. This is explained below.

505.6.3 "Shielding of *exterior building lighting fixtures*". This wording is unclear. This could mean fixtures on the exterior of the building, or fixtures exterior to the building, or building mounted exterior fixtures, or exterior fixtures intended to light the building. I propose "Shielding of site and building mounted exterior lighting fixtures" (assuming that is the intent).

Exception #1 "150 watt incandescent". How much is that? This is not a finite quantity appropriate for code language. I propose deletion of this exception because it is not needed, and would conflict with, the thresholds that are provided in my proposed shielding requirements.

Exception #2: Turning a blind eye by allowing uplight for some specific tasks and not others ignores the fact that most uplighting is exceptionally inefficient. For example, the amount of uplight that hits a facade and makes it back down to our eyes is much less than 50% of fixture lumens (assuming lambertian reflectance, which would be a best case scenario). The light that makes it back from a flag is much less. In an effort to strike a balance between want and need, I would propose that these uplight exemptions may continue to persist if the lighting power density is halved for these specific applications. Basically if you want to waste energy, waste half as much. The design community will almost certainly object but I offer the follow alternative solutions:

Downlight your facades, light them with very low wattage fixtures (LEDs) or don't light them at all.

Take down your flag, let it hang without light, or top light it. There is no law that states we must light the flag and I fail to see how it's patriotic to waste energy by lighting a flag at 3am.

Uplight statues or works of art with highly focused fixtures – not floods (my 75% rule). You can prove a 75% incidence with some simple geometry.

Exception #3: 'Historic lighting' is ill defined here. What does it mean; historic looking fixtures or the lighting of historic buildings or monuments?

In the case of the former, the historic fixtures are typically very glary and were never originally intended to be used with high intensity discharge sources. A perfect example is the use of the 'Washington Globe' in Georgetown, Washington, DC. These fixtures put less than 50% light down and as a result are over-lamped. They may look historic but actually cause adverse driving conditions, all in the name of history.

I would offer that all newly applied 'historic fixtures' must be retrofitted or manufactured to comply.

In the case of the latter, historic buildings should also be subject all façade lighting rules. When most historic building were built, façade lighting wasn't even conceived and thus the design was meant to be experienced in daylight. If the façade lighting can be done in a most effective way (75% rule), then by all means – do so. If façade lighting of a historic monument (like the National Cathedral in DC) is accomplished with massive floodlights, then it should not be attempted.

Exception #5: Why should emergency exit discharge lighting be any less subject to uplight limitation than any other exterior lighting? You can adequately illuminate a vast area in front of a door with a cutoff (pardon the term) sconce with whatever lamp package is desired.

Exception #6: The exception is actually encouraging the use of highly inefficient light sources. Low-voltage halogen lamps themselves are produce less than 20 lm/W and with transformer losses, the efficiency is even less.

Use LEDs or use exceptionally low-wattage fixtures. If you must, then do so with less.

Exception #7: Sign illumination, like façade lighting, is highly inefficient when done in the form of uplighting. A good example would be billboards, which I notice also have an exemption in power densities. The power of money and the special interest groups that wield it do not hold social welfare or energy efficiency as a priority. We're running out of energy – every little bit helps! If you have to do it – do it as efficiently as possible and downlight. Just think: you could light that same billboard with half as much energy.

Exception #10: it is vague and unenforceable. Who decides if "safety will be compromised", and by what criteria? This is a huge loophole as anyone could come up with some reason or claim that their wasteful solution was needed for "safety". This exception is not necessary – "safe" lighting can easily be provided

Public Comment 4:

Katherine C. Abernathy LC, IALD, Abernathy Lighting Design, Inc., representing the International Association of Lighting Designers, requests Disapproval.

Commenter's Reason: Outdoor shielding needs to be studied by lighting experts prior to it being approved. Since this is an energy conservation code, it should be limited to provisions that result in energy conservation. Glare prevention does not necessarily yield energy savings. There are some applications where some light above the horizon might be useful and be the most energy efficient option. This section restricts design in these applications. This change does not consistently lead to more efficient lighting designs and there are cases where the design might actually use more energy.

This proposal contains some ambiguous language that should be unacceptable for code language. Some of the non-standard technical terms and definitions that are vague and unclear are "Shielding of exterior building lighting fixtures","decorative styled" and "safety will be compromised".

Public Comment 5:

Hyman Kaplan, Hy-Lite Design, Inc., representing himself, requests Disapproval.

Commenter's Reason: There is not any proof that the use of shielded luminaries saves any energy compared to those with light emitted above horizon. This is an energy code, not a dark-sky code.

Public Comment 6:

Ken Sagan, National Association of Home Builders, requests Disapproval.

Commenter's Reason: The proponent in his Reason statement, states that New Mexico incorporated this into their Electrical Code under the Night Sky Protection Act. This proposal lies outside the scope of this energy code and may be more appropriately proposed in the electrical code as seen. This proposal has nothing to do with energy conservation merely with limiting the shielding of exterior lighting.

Final Action: AS AM AMPC____ D

EC152-07/08, Part I
202

NOTE: PART II DID NOT RECEIVE A PUBLIC COMMENT AND IS ON THE CONSENT AGENDA. PART II IS REPRODUCED FOR INFORMATIONAL PURPOSES ONLY FOLLOWING ALL OF PART I.

Proposed Change as Submitted:

Proponent: Daniel J. Walker, PE, Thomas Associates, Inc., representing the National Sunroom Association

PART I – IECC

Revise definition as follows:

SECTION 202 (IBC SECTION 1202)
DEFINITIONS

THERMAL ISOLATION. ~~A separation of conditioned spaces, between a sunroom addition and a dwelling unit,~~ Physical and space conditioning separation from conditioned space(s), consisting of existing or new wall(s), doors and/or windows. The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

Reason: The added text comes from the definition of *Thermal Isolation* in the 2006 IBC. The purpose of this code change, and the companion code change to the IBC, is to unify the definitions for this term within these codes. Currently the definition in the IRC and IECC is different than the one in the IBC. The revised definitions will all be identical, which should considerably reduce confusion for code enforcers and contractors.

Cost Impact: The code change proposal will not increase the cost of construction.

PART I – IECC
Committee Action: Disapproved

Committee Reason: This proposal appears to validate energy use without regulation outside of the building thermal envelope.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Shaunna Mozingo, City of Westminster,CO, representing the Colorado Chapter of the International Code Council, requests Approval as Submitted.

Commenter's Reason: The Colorado Chapter requests committee action be overturned and Part I be approved. EC152 Part II 07/08 was approved as submitted by the IRC B/E committee.

The results of the Palm Springs hearings have established Chapter 4 of the IECC and Chapter 11 of the IRC as two separate, distinct sets of minimum standards for the same structure, while the physical dynamics are the same in both.

Divergent actions on this item will lead to confusion and inconsistency in code enforcement and construction. Conflicting requirements devalue the benefits of the IRC as an effective stand alone document. When the differences are justified based on technical merit, we can all readily provide a reasonable explanation and achieve code compliance.

This is one of a series of public comments attempting to bring consistency back to the family of I-codes.

Final Action: AS AM AMPC____ D

NOTE: PART II REPRODUCED FOR INFORMATIONAL PURPOSES ONLY – SEE ABOVE

EC152-07/08, PART II – IRC BUILDING/ENERGY

Revise definition as follows:

SECTION R202
GENERAL DEFINITIONS

THERMAL ISOLATION. Physical and space conditioning separation from conditioned space(s) consisting of existing or new walls, doors and/or windows. The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

Reason: The added text comes from the definition of *Thermal Isolation* in the 2006 IBC. The purpose of this code change, and the companion code change to the IBC, is to unify the definitions for this term within these codes. Currently the definition in the IRC and IECC is different than the one in the IBC. The revised definitions will all be identical, which should considerably reduce confusion for code enforcers and contractors.

Cost Impact: The code change proposal will not increase the cost of construction.

PART II – IRC
Committee Action: **Approved as Submitted**

Committee Reason: This change will harmonize the definition with the IBC and the IECC.

Assembly Action: **None**

EC154-07/08

Appendix A, 202 (New), 401.2, Table 402.1.1, Table 402.1.3, 402.1.5 (New), Table 402.1.5 (New), Table 402.1.6 (New), Table 402.1.7 (New), 402.2.1, 402.2.2, 402.4.1, 402.4.1.1 (New), 402.4.1.2 (New), 402.4.1.3 (New), 402.4.1.4 (New), 402.4.1.5 (New), 402.4.1.6 (New), 402.7 (New), Table 402.7 (New), 403.2.4 (New), 403.4, 403.4.1 (New), 403.4.2 (New), 403.4.3 (New), 403.6, 404, 404.1, 404.2, Table 404.5.2(1)

Proposed Change as Submitted:

Proponent: Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, American Council for an Energy Efficient Economy (ACEEE); Jeff Harris, Alliance to Save Energy (ASE); Steven Rosenstock, Edison Electric Institute (EEI)

1. Add new text as follows:

NOTE: This proposed Appendix is entirely new text to the IECC. Rather than show all text underlined as new, the proposal is formatted to show ruled format to existing text in the main body of the code in order to show the energy efficiency improvements in comparison to the existing energy code.

APPENDIX A
MEASURES FOR INCREASED ENERGY EFFICIENCY
FOR VOLUNTARY ADOPTION BY JURISDICTIONS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance

Introduction. The purpose of Appendix A ("Appendix") to the International Energy Conservation Code (IECC) is to provide jurisdictions with additional energy efficiency measures that can be adopted on a voluntary basis in cases where the jurisdiction has an interest in increasing its energy conservation objectives beyond what the basic IECC provides. The Appendix can also serve as a publicly available repository of building energy code "best practices" that provides innovative ways of increasing energy efficiency that have been implemented in other jurisdictions. States and jurisdictions seeking additional energy efficiency options can review these optional measures and adopt them locally on a voluntary basis.

The measures in this version of the Appendix for the 2009 IECC can provide an approximate 30 percent national improvement in residential new construction energy efficiency as compared to the 2006 IECC and its supplement. Jurisdictions wishing to achieve this level of energy efficiency can adopt all the provision in this version. Jurisdictions seeking more modest increases in energy efficiency can adopt selected measures from this appendix as needed.

How to use this Appendix. The measures in this Appendix modify existing sections of the 2006 IECC or add new sections. The measures are numbered according to section numbering of the 2006 IECC and its supplement. Jurisdictions wishing to adopt some or all of these measures can replace selected sections in the 2006 IECC with the corresponding section in this Appendix through state or local amendments. Instructions are provided to "revise text as follows" or to add new text or tables to incorporate the desired changes.

The measures included in this Appendix for the 2009 IECC include the following:

- Section 202 General Definitions, including those needed to implement certain new measures
- Section 402 Building Thermal Envelope, including improved fenestration and insulation requirements and changes to certain U-value tables
- Section 402.4.1 Building thermal envelope, including improved air infiltration sealing to prevent thermal bypasses
- Section 402.7 Minimum opaque envelope requirements (Mandatory) as a new requirement
- Section 403.2 Ducts, including new requirements to improve distribution system efficiency
- Section 403.6 Equipment sizing, including certain limits on equipment oversizing
- Section 403.7 Service Water Heating, including measures to increase water heating system efficiencies
- Section 404 Electrical Power and Lighting Systems, including new requirements for certain efficiencies in selected residential lighting equipment
- Section 404 Simulated Performance Alternative (Performance), including improvements to criteria for conducting performance path simulations

Specific Energy Efficiency Measures Provided for Voluntary Adoption

GENERAL DEFINITIONS
SECTION A202

AIR BARRIER. A material intended to prevent the flow of air between a conditioned space and an unconditioned space.

LIGHT FIXTURE. A complete lighting unit consisting of a lamp or lamps, and ballasting (when applicable) together with the parts designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply. For built-in valence lighting, strings of low-voltage halogens, and track lights, each individual bulb shall count as a fixture.

QUALIFYING LIGHT FIXTURE. A hard-wired light fixture comprised of any of the following components: a) high efficacy luminaire; or b) exterior light fixtures controlled by a motion sensor(s) with integral photo-control photo-sensor.

QUALIFYING LIGHT FIXTURE LOCATIONS. Hard-wired light fixtures located in kitchens, dining rooms, living rooms, family rooms/dens, bathrooms, hallways, stairways, entrances, bedrooms, garage, utility rooms, home offices, and all outdoor fixtures mounted on a building or pole. This excludes portable luminaires, closets, unfinished basements, and landscape lighting.

IMPROVED BUILDING ENVELOPE MEASURES

2. Revise as follows:

A401.2 Compliance. Projects shall comply with Sections 401, 402.4, 402.5, 402.6, 402.7, and 403 (referred to as the mandatory provisions) and either:

1. Sections 402.1 through 402.3 (prescriptive); or
2. Section 404 (performance).

TABLE A402.1.1 (Supp)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT [a]

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[h]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[H]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] WALL R-VALUE
1	~~1.20~~ 0.65	0.75	~~0.37~~ 0.25	30	~~13~~ 15	3 / 4	13	0	0	0
2	~~0.75~~ 0.50	0.75	~~0.37~~ 0.25	~~30~~ 38	~~13~~ 15	4 / 6	13	~~0~~ 10/13	0	0
3	~~0.65~~ 0.40	0.65	~~0.40[e]~~ 0.25[e]	~~30~~ 38	~~13~~ 18	5 / 8	19	~~0~~ 10/13	0	5/13
4 except Marine	~~0.40~~ 0.35	0.60	NR	~~38~~ 49	~~13~~ 18	5 / 10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	~~38~~ 49	~~19 or 13+5[g]~~ 21	13 / 17	30[f]	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	~~49~~ 60	~~19 or 13+5[g]~~ 21	15 / 19	30[f]	~~10~~ 15/19 ~~13~~	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	~~49~~ 60	~~21~~ 24	19 / 21	~~30~~ 38[f]	~~10~~ 15/19 ~~13~~	10, 4 ft	10/13

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. R-19 shall be permitted to be compressed into a 2 × 6 cavity.
b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
c. "15 / 19" means R-15 continuous insulated sheathing 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 insulated sheathing on the interior or exterior of the home."10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall. ~~The first R-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.~~
d. R-5 shall be added to the required slab edge *R*-values for heated slabs.
e. There are no SHGC requirements in the Marine zone.
f. Or insulation sufficient to fill the framing cavity, R-19 minimum.
g. ~~"13+5" means R-13 cavity insulation plus R-5 insulated sheathing.~~ Any combination of insulation shall be permitted to meet the requirements by summing the R-value of the cavity insulation and the R-value of the insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2

TABLE A402.1.3
EQUIVALENT U-FACTORS [a]

CLIMATE ZONE	FENES-TRATION U-FACTOR	SKY-LIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	~~1.20~~ 0.65	0.75	0.035	~~0.082~~ 0.069	0.197	~~0.064~~ 0.060	0.360	0.477
2	~~0.75~~ 0.50	0.75	~~0.035~~ 0.029	~~0.082~~ 0.069	0.165	~~0.064~~ 0.060	~~0.360~~ 0.059	0.477
3	~~0.65~~ 0.40	0.65	~~0.035~~ 0.029	~~0.082~~ 0.056	0.141	~~0.047~~ 0.046	~~0.220~~ 0.059	0.136
4 except Marine	~~0.40~~ 0.35	0.60	~~0.030~~ 0.024	~~0.082~~ 0.056	0.141	~~0.047~~ 0.046	0.059	0.065
5 and Marine 4	0.35	0.60	~~0.030~~ 0.024	~~0.060~~ 0.051	0.082	~~0.037~~ 0.033	0.059	0.065
6	0.35	0.60	~~0.026~~ 0.020	~~0.060~~ 0.051	0.060	0.033	~~0.059~~ 0.050	0.065
7 and 8	0.35	0.60	~~0.026~~ 0.020	~~0.057~~ 0.047	0.057	~~0.033~~ 0.027	~~0.041~~ 0.050	~~0.057~~ 0.065

(Footnotes remain unchanged)

3. Add new text and tables as follows:

A402.1.5 Envelope component default values. When calculating the U-factor of an assembly as part of Section 402.1.3, 402.1.4, or 404.5.2, the values in Table 402.1.5 through 402.1.7 shall be used unless alternate values are documented and approved by the code official. In addition, the U-factor of the assembly shall be calculated using a series-parallel calculation.

TABLE A402.1.5
FRAME WALL COMPONENT DEFAULT VALUES

COMPONENT	DEFAULT VALUE	
Interior Air Film R-Value	0.68	
Drywall Layer R-Value	0.45	
Cavity Layer R-Values	Insulation: As Specified	Framing: R-1.25 per inch of wood
Standard Reference Design Insulation / Framing Fraction	Insulation: 86%	Framing: 14%
Proposed Design Default Insulation / Framing Fraction	Insulation: 77%	Framing: 23%
Sheathing Layer R-Value	0.63	
Siding Layer R-Value	0.44	
Exterior Air Film R-Value	0.45	

TABLE A402.1.6
FLOOR COMPONENT DEFAULT VALUES

COMPONENT	DEFAULT VALUE	
Interior Air Film R-Value	0.92	
Floor Covering R-Value	1.23	
Floor Subfloor R-Value	0.63	
Cavity Layer R-Values	Insulation: As Specified	Framing: R-1.25 per inch of wood
Standard Reference Design Insulation / Framing Fraction	Insulation: 92%	Framing: 8%
Proposed Design Default Insulation / Framing Fraction	Insulation: 90%	Framing: 10%
Exterior Air Film R-Value	0.92	

TABLE A402.1.7
CEILING COMPONENT DEFAULT VALUES

COMPONENT	DEFAULT VALUE	
Interior Air Film R-Value	0.61	
Drywall Layer R-Value	0.45	
Cavity Layer R-Values	Insulation: As Specified	Framing: R-1.25 per inch of wood
Standard Reference Design Insulation / Framing Fraction	Insulation: 93%	Framing: 7%
Proposed Design Default Insulation / Framing Fraction	Insulation: 89%	Framing: 11%
Exterior Air Film R-Value	0.61	

4. Revise as follows:

A402.2.1 Ceilings with attic spaces. When Section 402.1.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly R-38 shall be deemed to satisfy the requirement for R-49 or higher wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves.

A402.2.2 Ceilings without attic spaces. Where Section 402.1.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section 402.1.1 shall be limited to 500 square feet (46 m^2) or 20% of the total insulated ceiling area, which ever is less.

AIR INFILTRATION SEALING TO PREVENT THERMAL BYPASSES

A402.4.1 (Supp) Building thermal envelope. The building thermal envelope shall be durably sealed to limit infiltration and prevent thermal bypasses. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The thermal envelope, including insulation and air barriers, shall be inspected in accordance with Sections 402.4.1.1 through 402.4.1.6. ~~The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material:~~

1. ~~All joints, seams and penetrations.~~
2. ~~Site-built windows, doors and skylights.~~
3. ~~Openings between window and door assemblies and their respective jambs and framing.~~
4. ~~Utility penetrations.~~
5. ~~Dropped ceilings or chases adjacent to the thermal envelope.~~
6. ~~Knee walls.~~
7. ~~Walls and ceilings separating a garage from conditioned spaces.~~
8. ~~Behind tubs and showers on exterior walls.~~
9. ~~Common walls between dwelling units.~~
10. ~~Attic access openings.~~
11. ~~Other sources of infiltration.~~

5. Add new text and tables as follows:

A402.4.1.1 Walls adjoining exterior walls or unconditioned spaces. Fully insulated wall in substantial contact with air barrier at both interior and exterior, or for Climate Zones 1 thru 3, sealed exterior air barrier aligned with fully supported insulation. The following areas shall meet these requirements: wall behind shower/tub, wall behind fireplace, insulated attic slopes for un-vented attic spaces, attic knee walls, skylight shaft walls, wall adjoining porch roof, staircase walls, double walls.

A402.4.1.2 Floors between conditioned and exterior spaces. An air barrier shall be installed at any exposed insulation edges. Insulation shall be installed to maintain substantial contact w/ sub-floor above and air barrier below. The following areas shall meet these requirements: Insulated floor above un-conditioned and semi-conditioned space.

A402.4.1.3 Shafts. Openings and gaps to unconditioned space shall be fully sealed with an air barrier. The following areas shall meet these requirements: duct, piping and flue shafts and associated penetrations.

A402.4.1.4 Attic and ceiling interface. Attic penetrations and dropped ceilings shall include a full interior air barrier aligned with insulation with any gaps fully sealed. Insulation shall fit snugly in opening and the opening air barrier shall be fully gasketed. The following areas shall meet these requirements: attic access panel, attic drop-down stair, dropped ceiling/soffit, recessed lighting fixtures, whole-house fan.

A402.4.1.5 Common walls between dwelling units. Gap between drywall shaft wall (common wall) and structural framing between units shall be sealed at all exterior boundary conditions.

A402.4.1.6 Gaps and penetrations. Gaps and penetrations in the thermal envelope of the home shall be sealed and insulated. The following areas shall meet these requirements: the perimeters of windows, doors, skylights, and utility penetrations, hose bibs, exterior electrical outlets and light fixtures.

MINIMUM INSULATION REQUIREMENTS

A402.7 Minimum opaque envelope requirements (Mandatory). The thermal requirements for opaque envelope components shall not be less than the requirements in Table 402.7 when determining alternatives to the R-values in Table 402.1.1 under Sections 402.1.3, 402.1.4, or 404.

TABLE A402.7
MINIMUM INSULATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	STEEL FRAME WALL CONTINUOUS R-VALUE [c]	FLOOR R-VALUE	BASEMENT WALL R-VALUE	SLAB R-VALUE & DEPTH	CRAWL SPACE WALL R-VALUE
1	25	11	0	R-11+3	11	0	0	0
2	25	11	3	R-11+3	11	0	0	0
3	25	11	4	R-11+3	13	0	0	0
4 except Marine	30	11	4	R-11+3	13	5/11 [b]	5, 2ft	5/11 [b]
5 and Marine 4	30	13	5	R-13+5, or R-15+4, or R-21+3	19	5/11 [b]	5, 2ft	5/11 [b]
6	38 [a]	13	13	R-13+5, or R-15+4, or R-21+3	19	5/11 [b]	10, 2ft	5/11 [b]
7 and 8	38 [a]	19	15	R-13+9, or R-19+8, or R-25+7	19	5/11 [b]	10, 2ft	5/11 [b]

a. R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves or the design of the roof/ceiling assembly does not allow sufficient space for the required insulation. This reduction of insulation shall be limited to 500 square feet (46 m^2) of ceiling area.

b. The first R-value applies to continuous insulation, the second to framing cavity insulation; either insulation configuation meets the requirement.

c. Cavity insulation R-value is listed first, followed by continuous insulation R-value.

IMPROVEMENTS TO DUCT DISTRIBUTION SYSTEMS EFFICIENCY

A403.2.4 Distribution system efficiency. Ducts shall be located completely within the building thermal envelope or achieve an equivalent distribution efficiency of 0.88 or greater.

Exceptions:

1. In climate zones 1-2, duct systems that supply air from cooling equipment with an efficiency that exceeds prevailing federal minimum standards by at least 15%;
2. In climate zone 3, duct systems that supply air from either cooling equipment or heating equipment with an efficiency that exceeds prevailing federal minimum standards by at least 15%
3. In climate zones 4-8, duct systems that supply air from heating equipment with an efficiency that exceeds prevailing federal minimum standards by 15%.

SERVICE WATER HEATING EFFICIENCY IMPROVEMENTS

6. Revise as follows:

A403.4 Service Water Heating.

7. Add new text as follows:

A403.4.1 Insulation. All Service Hot Water piping shall be insulated to at least R-2 for the distance between the Service Water Heater to within 5 feet of each fixture connected to the hot water pipe.

> **Exception:** Distribution systems that supply hot water from Service Water Heating systems with an efficiency that exceeds prevailing federal minimum standards by at least 15% for gas service water heating equipment and achieve efficiency of at least 1.0 EF for electric service water heating equipment.

A403.4.2 Stub-in for solar water. All Service Water Heating distribution systems shall have a stub-in connection point for future Solar Hot Water Systems in an accessible location within 5 feet of the roof.

> **Exception:** Distribution systems that supply hot water from Service Water Heating systems with an efficiency that exceeds prevailing federal minimum standards by at least 15% for gas service water heating equipment and achieve efficiency of at least 1.0 EF for electric service water heating equipment.

8. Revise as follows:

A403.4.3 Circulating hot water systems. All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

IMPROVED EQUIPMENT SIZING REQUIREMENTS

A403.6 Equipment sizing. Heating and cooling equipment shall be sized in accordance with Section M1401.3 of the *International Residential Code*.

The maximum oversizing limit for air conditioners and air-source and ground-source heat pumps is 15% with the following two exceptions: single-speed air-source and ground-source heat pumps in buildings with heating loads that exceed cooling loads have a limit of 25%, and multi-stage heat pumps do not have a strict limit, but shall be sized to allow adequate humidity control in the cooling mode. The maximum oversizing limit for gas, oil or propane heating equipment is 40%.

The following operating conditions shall be used in the sizing calculations and verified where reviewed by the code official:

1. Outdoor temperatures shall be the 99.0% and 1.0% design temperatures as published in the ASHRAE Handbook of Fundamentals for the home's location or most representative city for which design temperature data are available;
2. Indoor temperatures shall be 75 F for cooling and 70 F for heating;
3. Infiltration rate shall be selected as "tight", or the equivalent term.

In specifying equipment, the next available manufactured size may be used. In addition, indoor and outdoor coils shall be matched in accordance with ARI Standard 210/240.

RESIDENTIAL LIGHTING EQUIPMENT EFFICIENCY

SECTION 404 (Supp)
ELECTRICAL POWER AND LIGHTING SYSTEMS

A404.1 Dwelling unit interior and exterior lighting power (Prescriptive). 50% of all dwelling unit interior and exterior hard-wired lighting sockets shall be a qualifying light fixture. All exterior lighting equipment shall be a qualifying light fixture or shall comply with the exterior lighting power requirements of Section 505.7

Exceptions:

1. Swimming pool lighting systems
2. Landscape lighting systems

A404.2 (Supp) Interior lighting power (Prescriptive). Lighting in spaces other than dwelling units, e.g. common areas, shall be high efficacy luminaires or shall comply with the interior lighting power requirements in Section 505.5.

~~**Exception:** Dwelling units.~~

EFFICIENCY IMPROVEMENTS TO SIMULATED PERFORMANCE ALTERNATIVE

SECTION A404
SIMULATED PERFORMANCE ALTERNATIVE
(Performance)

404.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, lighting, and service water heating energy only.

TABLE A404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3 Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified[a] As proposed As proposed
Basement and crawl-space walls	Type: same as proposed Gross Area: same as proposed U-Factor: from Table 402.1.3, with insulation layer on interior side of walls	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified[a]
Above-grade floors	Type: wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified[a]
Ceilings	Type: wood frame Gross Area: same as proposed U-Factor: from Table 402.1.3	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified[a]
~~Doors~~	~~Area: 40 ft²~~ ~~Orientation: North~~ ~~*U*-Factor: same as fenestration from Table 402.1.3~~	~~As proposed~~ ~~As proposed~~ ~~As proposed~~
~~Glazing~~Fenestration[~~a~~ b]	Total area[~~b~~c] = (a) The proposed ~~glazing~~fenestration area; where the proposed ~~glazing~~fenestration area is less than ~~18%~~15% of the conditioned floor area (b) ~~18%~~15% of the conditioned floor area; where the proposed ~~glazing~~fenestration area is ~~18%~~15% or more of the conditioned floor area Orientation: equally distributed to four cardinal compass orientations (N, E, S & W)	As proposed As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	U-Factor: from Table 402.1.1~~2~~ SHGC: For glazing, which shall equal the total area as defined above minus 40 ft^2, from Table 402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used; for opaque doors, which shall equal 40 ft^2, SHGC = 0 for all climates, equally distributed to four cardinal compass orientations. Interior shade fraction: Summer (all hours when cooling is required) = ~~0.70~~ 0.90 Winter (all hours when heating is required) = ~~0.85~~ 0.90 External shading: none	As proposed As proposed Same as standard reference design[~~c~~ d] As proposed
Air Exchange Rate	Specific Leakage Area (SLA)[~~d~~ e] = ~~0.00036 assuming no energy recovery~~ 0.00015 combined with the mechanical ventilation rate, which shall be 0.01 x CFA + 7.5 x (Nbr+1) where: CFA = conditioned floor area Nbr = number of bedrooms and assuming continuous balanced ventilation using a energy/heat recovery ventilator with a recovery efficiency of 76% [g]	For residences that are not tested, ~~the same as the standard reference design~~ 0.00060 SLA assuming no energy recovery For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[~~e~~f] but not less than 0.35 ACH For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate [~~e~~f] combined with the mechanical ventilation rate [g], [~~f~~] which shall not be less than 0.01 x CFA + 7.5 x (Nbr+1) where: CFA = conditioned floor area Nbr = number of bedrooms
Internal Gains	IGain = 17,900 + 23.8 x CFA + 4104 x Nbr + $\Delta IG_{lighting}$ (Btu/day per dwelling unit) Where $\Delta IG_{lighting}$ represents the reduced internal gains from efficient lighting as defined by the lighting building component.	~~Same as standard reference design,~~ IGain = 17,900 + 23.8 x CFA + 4104 x Nbr + $\Delta IG_{lighting}$ (Btu/day per dwelling unit) Where $\Delta IG_{lighting}$ represents the reduced internal gains from efficient lighting as defined by the lighting building component.
Heating systems[~~h,~~ i, j]	Fuel type: same as proposed design Efficiencies: Electric: air-source heat pump with ~~prevailing federal minimum~~ efficiency as proposed, unless the proposed is greater than 15% above the federal minimum, in which case it shall be 15% above the federal minimum. Nonelectric furnaces: natural gas furnace with ~~prevailing federal minimum~~ efficiency as proposed, unless the proposed is greater than 15% above the federal minimum, in which case it shall be 15% above the federal minimum Nonelectric boilers: natural gas boiler with ~~prevailing federal minimum~~ efficiency as proposed, unless the proposed is greater than 15% above the federal minimum, in which case it shall be 15% above the federal minimum Capacity: sized in accordance with Section M1401.3 of the *International Residential Code*	As proposed As proposed As proposed As proposed As proposed
Cooling systems[~~h, j~~ i, k]	Fuel type: Electric Efficiency: as proposed, unless the proposed efficiency is greater than 15% above the ~~in accordance with~~ prevailing federal minimum ~~standards~~ efficiency, in which case it shall be 15% above the federal minimum. Capacity: sized in accordance with Section M1401.3 of the *International Residential Code*	As proposed As proposed As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Service Water Heating[~~h, k~~ i, l]	Fuel type: same as proposed design Efficiency: as proposed, unless the proposed efficiency is greater than 15% above the ~~in accordance with~~ prevailing federal minimum ~~standards~~ efficiency, in which case it shall be 15% above the federal minimum. Use: ~~gal/day=30 + (10 x N_{br})~~ Same as proposed design	As proposed As proposed ~~Same as standard reference~~ Use: gal/day=30 + (10 x N_{br})
Thermal distribution systems	A thermal distribution system efficiency (DSE) of ~~0.80~~ 0.88 shall be applied to both the heating and cooling system efficiencies	~~Same as standard reference design,~~ A thermal distribution system efficiency (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies, except as specified by Table 404.5.2(2)
Thermostat	Type: Manual, cooling temperature setpoint = ~~78~~ 75°F; Heating temperature set point = ~~68~~ 70 °F	Same as standard reference
Lighting	kWh/yr = (455 + 0.80 * CFA) + □kWh/yr where: □kWh/yr = [29.5 – 0.5189*CFA *50% –295.12*50% + 0.0519*CFA] Internal gains in the Standard Reference Design shall be reduced by 90% of the impact from efficient lighting, calculated in btu/day using the following equation: $\Delta IG_{lighting}$ = - 0.90 * ΔkWh/yr * 10^6 / 293 / 365	kWh/yr = (455 + 0.80 * CFA) + □kWh/yr where: □kWh/yr = [29.5 – 0.5189*CFA*FL% – 295.12*FL% + 0.0519*CFA] FL% = the ratio of Qualifying Light Fixtures to all light fixtures in Qualifying Light Fixture Locations. The Proposed Design shall not have FL% more than 50% from CFL. Internal gains in the Proposed Design shall be reduced by 90% of the impact from efficient lighting, calculated in btu/day using the following equation: $\Delta IG_{lighting}$ = 0.90 * ΔkWh/yr * 10^6 / 293 / 365

a. Insulation installation, including percent of insulation missing and insulation substantially filling cavity and, shall be determined and documented by an independent party approved by the code official.

~~a~~b. Glazing shall be defined as sunlight-transmitting fenestration, including the area of sash, curbing or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight-transmitting fenestration assemblies in walls bounding conditioned basements. For doors where the sunlight-transmitting opening is less than 50% of the door area, the glazing area is the sunlight transmitting opening area. For all other doors, the glazing area is the rough frame opening area for the door including the door and the frame.

~~b~~c. For residences with conditioned basements, R-2 and R-4 residence and townhouses, the following formula shall be used to determine glazing area:

AF = A_s x FA x F

Where:

AF = Total glazing area.

A_s = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 x below-grade boundary wall area).

F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

And where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

~~c~~d. For fenestrations facing within 15 degrees (0.26 rad) of true south that are directly coupled to thermal storage mass, the winter interior shade fraction shall be permitted to be increased to 0.95 in the proposed design.

~~d~~e. Where Leakage Area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where:

SLA = L/CFA

where L and CFA are in the same units.

~~e~~f. Tested envelope leakage shall be determined and documented by an independent party approved by the code official. Hourly calculations as specified in the 2001 ASHRAE Handbook of Fundamentals, Chapter

26, page 26.21, Equation 40 (Sherman-Grimsrud model) or the equivalent shall be used to determine the energy loads resulting from infiltration.

~~f~~g. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE Handbook of Fundamentals page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE Handbook of Fundamentals, page 26.19 for intermittent mechanical ventilation.

~~g~~h. Thermal Storage Element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

~~h~~i. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

~~i~~j. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design. For electric heating systems, the prevailing federal minimum efficiency air-source heat pump shall be used for the standard reference design.

~~j~~k. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

~~k~~l. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum Energy Factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

A404.2 Mandatory requirements. Compliance with this Section requires that the criteria of Sections A401, A402.4, A402.5, A402.6, A402.7, and A403 be met.

Reason: The states have long served as "living laboratories" for many types of public policy issues. Solutions to problems at the state level have often been adapted to meeting national needs based on successful state experience. The same concept can be applied to building energy codes. Indeed, it not uncommon for code measures that have been successful at the state level to make their way into the IECC in any given development cycle. We recommend that the ICC take an active role in compiling a catalog of state energy code best practices and innovations that have been tested at the state level and could potentially be included in the national IECC code.

The proponents expect that if this Appendix concept is adopted, states, other jurisdictions and other interested parties will make useful contributions during each IECC code development cycle. In addition, states and jurisdictions seeking additional energy efficiency options will be able to review these optional measures and adopt them locally on a voluntary basis.

The purpose of the new Appendix A ("Appendix") to the International Energy Conservation Code (IECC) is to provide jurisdictions with additional energy efficiency measures that can be adopted on a voluntary basis in cases where the jurisdiction has an interest in increasing its energy conservation objectives beyond what the basic IECC provides. The Appendix can also serve as a publicly available repository of building energy code "best practices" that provides innovative ways of increasing energy efficiency that have been tried in other jurisdictions. The use of appendices in other ICC codes has set a precedent for this proposal.

Many of the technical topics of interest to the IECC community have been addressed in energy codes adopted by the states. For example, California's Title 24 energy code now includes provisions for residential lighting. Several states have provisions requiring higher heating equipment efficiencies while maintaining consistency with NAECA. Some jurisdictions have adopted local window efficiency requirements that exceed those of ENERGY STAR, and some states have addressed duct leakage and sealing. For the initial version of this Appendix, the proponents have proposed optional measures for residential lighting efficiency, improved building envelope requirements , building envelope air infiltration and other measures that can provide an approximate 30 percent improvement in residential new construction energy efficiency..

The proponents urge the IECC community to adopt this Appendix concept. This will provide jurisdictions with more choice and flexibility in addressing local energy efficiency needs through access to energy code best practices that have been tested in other jurisdictions, but that have not been included in the basic IECC. As they are included in an Appendix, these measures are optional for jurisdictions to adopt on a voluntary basis.

Cost Impact: The code change proposal will not increase the cost of construction. The code change proposal could increase the cost of construction if adopted voluntarily by jurisdictions.

Committee Action: Disapproved

Committee Reason: Introduction of an appendix that provides, in essence, an "above code" program will be chaotic, at best. The IECC should be reflexive of the baseline requirements the members of the IECC Code development process have determined should be the level of stringency. We should not be providing choices that could lead to confusion in the market place and in the regulatory areas. In addition, there are many technical flaws in the proposed text and tables that the IECC Committee has discussed and disapproved or modified in the last several days of this committee meeting.

Assembly Action: **None**

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Brian Dean, ICF International, representing the Energy Efficient Codes Coalition; Bill Prindle, Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Steven Rosenstock, Edison Electric Institute, Harry Misuriello, American Council for Energy Efficient Economy, requests Approval as Modified by this Public Comment.

Modify proposal as follows:

APPENDIX A
MEASURES FOR INCREASED ENERGY EFFICIENCY FOR VOLUNTARY ADOPTION BY JURISDICTIONS

Introduction. The purpose of Appendix A ("Appendix") to the International Energy Conservation Code (IECC) is to provide jurisdictions with an alternative residential energy chapter and related provisions containing all of the measures in the IECC plus additional energy efficiency measures that can be adopted on a voluntary basis in cases where the jurisdiction has an interest in increasing its energy conservation objectives beyond what the basic IECC provides. The Appendix ~~can~~ also serves as a publicly available repository of building energy code "best practices" that provides innovative ways of increasing energy efficiency that have been implemented in other jurisdictions. States and jurisdictions seeking additional energy efficiency options can review these optional measures and adopt them locally on a voluntary basis.

~~The measures in this version of the Appendix for the 2009 IECC can provide an approximate 30 percent national improvement in residential new construction energy efficiency as compared to the 2006 IECC and its supplement. Jurisdictions wishing to achieve this level of energy efficiency can adopt all the provision in this version. Jurisdictions seeking more modest increases in energy efficiency can adopt selected measures from this appendix as needed.~~

How to use this Appendix. This Appendix contains a complete alternate residential energy chapter (chapter 4), along with definitions (chapter 2) and referenced standards (chapter 6), that can be adopted in lieu of the IECC chapters 2, 4 and 6. ~~The measures in this Appendix modify existing sections of the 2006 IECC or add new sections. The measures are numbered according to section numbering of the 2006 IECC and its supplement.~~ Jurisdictions wishing to adopt some or all of these measures can replace selected sections or entire chapters 2, 4 and 6 in the ~~2006~~ IECC with the corresponding section in this Appendix through state or local amendments. ~~Instructions are provided to "revise text as follows" or to add new text or tables to incorporate the desired changes.~~

~~The measures included in this Appendix for the 2009 IECC include the following:~~
- ~~Section 202 General Definitions, including those needed to implement certain new measures~~
- ~~Section 402 Building Thermal Envelope, including improved fenestration and insulation requirements and changes to certain U-value tables~~
- ~~Section 402.4.1 Building thermal envelope, including improved air infiltration sealing to prevent thermal bypasses~~
- ~~Section 402.7 Minimum opaque envelope requirements (Mandatory) as a new requirement~~
- ~~Section 403.2 Ducts, including new requirements to improve distribution system efficiency~~
- ~~Section 403.6 Equipment sizing, including certain limits on equipment oversizing~~
- ~~Section 403.7 Service Water Heating, including measures to increase water heating system efficiencies~~
- ~~Section 404 Electrical Power and Lighting Systems, including new requirements for certain efficiencies in selected residential lighting equipment~~
- ~~Section 404 Simulated Performance Alternative (Performance), including improvements to criteria for conducting performance path simulations~~

~~SPECIFIC ENERGY EFFICIENCY MEASURES PROVIDED FOR VOLUNTARY ADOPTION~~
ALTERNATE RESIDENTIAL ENERGY EFFICIENCY CHAPTERS
CHAPTER A2
DEFINITIONS

Copy Chapter 2 of the 2006 IECC (as amended by the Supplement) in its entirety and revise as follows:

GENERAL DEFINITIONS
SECTION A202

HIGH-EFFICACY LAMPS ~~LUMINAIRE (Supp)~~. ~~A lighting fixture that does not contain a medium screw base socket (E24/E26) and whose lamps have a minimum efficacy of~~ Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts,
2. 50 lumens per watt for lamps over 15 watts to 40 watts,
3. 40 lumens per watt for lamps 15 watts or less.

AIR BARRIER. ~~A material intended to prevent the flow of air between a conditioned space and an unconditioned space.~~ Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material, or a combination of materials.

~~**LIGHT FIXTURE.** A complete lighting unit consisting of a lamp or lamps, and ballasting (when applicable) together with the parts designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply. For built-in valence lighting, strings of low-voltage halogens, and track lights, each individual bulb shall count as a fixture.~~

~~**QUALIFYING LIGHT FIXTURE.** A hard-wired light fixture comprised of any of the following components: a) high efficacy luminaire; or b) exterior light fixtures controlled by a motion sensor(s) with integral photo-control photo-sensor.~~

~~**QUALIFYING LIGHT FIXTURE LOCATIONS.** Hard-wired light fixtures located in kitchens, dining rooms, living rooms, family rooms/dens, bathrooms, hallways, stairways, entrances, bedrooms, garage, utility rooms, home offices, and all outdoor fixtures mounted on a building or pole. This excludes portable luminaires, closets, unfinished basements, and landscape lighting.~~

~~IMPROVED BUILDING ENVELOPE MEASURES~~
CHAPTER A4
RESIDENTIAL ENERGY EFFICIENCY

Copy Chapter 4 of the 2006 IECC (as amended by the Supplement) in its entirety and renumber and revise as follows:

A401.2 Compliance. Projects shall comply with Sections A401, A402.4, A402.5, A402.6, A402.7, and A403 (referred to as the mandatory provisions) and either:

1. Sections A402.1 through A402.3 (prescriptive); or
2. Section A404 (performance).

TABLE A402.1.1 (Supp)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT [a]

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[h]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[h]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] WALL R-VALUE
1	0.65	0.75	0.25	30	~~15~~ 16	3 / 4	13	0	0	0
2	0.50	0.75	0.25	38	~~15~~ 16	4 / 6	13	10/13	0	0
3	0.40	0.65	0.25[e]	38	~~18~~ 20	5 / 8	19	10/13	0	5/13
4 except Marine	0.35	0.60	NR	49	~~18~~ 20	5 / 10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	49	~~21~~ 22	13 / 17	30[f]	10/13	10, 2 ft	10/13
6	0.32 ~~0.35~~	0.60	NR	60	~~21~~ 22	15 / 19	30[f]	15/19	10, 4 ft	10/13
7 and 8	0.32 ~~0.35~~	0.60	NR	60	24	19 / 21	38[f]	15/19	10, 4 ft	10/13

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. R-19 shall be permitted to be compressed into a 2 x 6 cavity.
b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
c. "15 / 19" means R-15 continuous insulated sheathing 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 insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall. Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.
d. R-5 shall be added to the required slab edge *R*-values for heated slabs.
e. There are no SHGC requirements in the Marine zone.
f. Or insulation sufficient to fill the framing cavity, R-19 minimum.
g. Any combination of insulation shall be permitted to meet the requirements through calculating an equivalent UA or by summing the R-value of the cavity insulation and the R-value of the insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2, but shall also meet the minimum insulation requirements in Table 402.1.1, but in no case shall insulated sheathing be less than R-2.

TABLE A402.1.3 (Supp)
EQUIVALENT U-FACTORS [a]

CLIMATE ZONE	FENES-TRATION U-FACTOR	SKY-LIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR[c]	CRAWL SPACE WALL U-FACTOR
1	0.65	0.75	~~0.035~~ 0.034	0.069	0.197	~~0.060~~ 0.063	0.360	0.477
2	0.50	0.75	~~0.029~~ 0.027	0.069	0.165	~~0.060~~ 0.063	~~0.059~~ 0.360	0.477
3	0.40	0.65	~~0.029~~ 0.027	~~0.056~~ 0.055	0.141	~~0.046~~ 0.048	~~0.059~~ 0.091	0.136

CLIMATE ZONE	FENES-TRATION U-FACTOR	SKY-LIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR[c]	CRAWL SPACE WALL U-FACTOR
4 except Marine	0.35	0.60	~~0.024~~ 0.020	~~0.056~~ 0.055	0.141	~~0.046~~ 0.048	0.059	0.065
5 and Marine 4	0.35	0.60	~~0.024~~ 0.020	~~0.051~~ 0.052	0.082	~~0.033~~ 0.032	0.059	0.065
6	0.32 ~~0.35~~	0.60	~~0.020~~ 0.017	~~0.051~~ 0.052	0.060	~~0.033~~ 0.032	0.050	0.065
7 and 8	0.32 ~~0.35~~	0.60	~~0.020~~ 0.017	~~0.047~~ 0.049	0.057	0.027	0.050	0.065

(Footnotes a and b remain unchanged)
c. Basement wall U-factor of 0.360 in warm-humid locations as defined by Figure 301.1 and Table 301.2.

A402.1.5 Envelope Component Descriptions and Default Values. When calculating the U-factor of an assembly as part of Section A402.1.3, A402.1.4, or A404.5.2, the values in Table A402.1.5.1 through A402.1.5.3~~7~~ shall be used unless alternate values are approved by the code official. In addition, the U-factor of the assembly shall be calculated using a series-parallel calculation with the default framing fractions in Table A402.1.5.1 through A402.1.5.3. Subject to approval by the code official, the frame fractions for the proposed design shall be permitted to be determined by the type of construction (Satisfactory, Intermediate or Advanced) as defined in sections A402.1.5.1 through A402.1.5.3.

A402.1.5.1 Wood stud frame walls. The type of construction (Satisfactory, Intermediate or Advanced) for determination of default framing fractions in wood stud frame walls are defined as follows:

Satisfactory Insulation and Framing Fractions:
Satisfactory wood stud frame walls include studs framed on 16 inch centers with double top plate and single bottom plate. Corners use three studs and each opening is framed using two studs.

Studs and plates: 21%
Insulated cavity: 75%
Headers: 4%

Intermediate Insulation and Framing Fractions:
Intermediate wood stud frame walls include studs framed on 16 inch centers with double top plate and single bottom plate. Corners use two studs or other means of fully insulating corners, and each opening is framed by two studs.

Studs and plates: 18%
Insulated cavity: 78%
Headers: 4%

Advanced Insulation and Framing Fractions:
Advanced wood stud frame walls include studs framed on 24 inch centers with double top plate and single bottom plate. Corners use two studs or other means of fully insulating corners, and one stud is used to support each header.

Studs and plates: 13%
Insulated cavity: 83%
Headers: 4%

TABLE A402.1.5.1
FRAME WALL COMPONENT DEFAULT VALUES

Component	Default Value	
Interior Air Film R-Value	0.68	
Drywall Layer R-Value	0.45	
Cavity Layer R-Values	Insulation: As Specified	Framing: R-1.25 per inch of wood
Standard Reference Design Insulation / Framing Fraction	Insulation: ~~77~~ 83%	Framing: ~~23~~ 17%
Proposed Design Default Insulation / Framing Fraction	Insulation: ~~77~~ 78%	Framing: ~~23~~ 22%
Insulating Sheathing Layer R-Value	0 or as installed	
Structural Sheathing Layer R-Value	0.62 ~~63~~	
Siding Layer R-Value	0.61 ~~44~~	
Exterior Air Film R-Value	0.25 ~~45~~	

A402.1.5.2 Wood frame floors. The type of construction (Satisfactory, Intermediate or Advanced) for determination of default framing fractions in wood stud frame floors are defined as follows:

Satisfactory Insulation and Framing Fractions:
Satisfactory wood floors include open joist systems framed 12 inch centers or solid joists framed 16 inch centers.
Framing: 12%
Insulated cavity: 88%

Intermediate Insulation and Framing Fractions:
Intermediate wood floors include open joist systems framed 16 inch centers or solid joists framed 20 inch centers.
Framing: 10%
Insulated cavity: 90%

Advanced Insulation and Framing Fractions:
Advanced wood floors include open joist systems framed 20 inch centers or joists framed 24 inch centers.
Framing: 8%
Insulated cavity: 92%

TABLE A402.1.5.2 ~~6~~
FLOOR COMPONENT DEFAULT VALUES

Component	Default Value	
Interior Air Film R-Value	0.92	
Floor Covering R-Value	1.23	
Floor Subfloor R-Value	0.94 ~~63~~	
Cavity Layer R-Values	Insulation: As Specified	Framing: R-1.25 per inch of wood
Standard Reference Design Insulation / Framing Fraction	Insulation: 92%	Framing: 8%
Proposed Design Default Insulation / Framing Fraction	Insulation: 90%	Framing: 10%
Exterior Air Film R-Value	0.92	

A402.1.5.3 Wood frame ceilings. The type of construction (Satisfactory, Intermediate or Advanced) for determination of default framing fractions in wood stud frame ceilings are defined as follows:

Satisfactory Insulation and Framing Fractions:
Satisfactory ceiling insulation and framing assumes tapering of insulation depth around the perimeter with resultant decrease in thermal resistance. An increased R-value is assumed in the center of the ceiling due to the effect of piling leftover insulation.
Framing: 11%
Insulated cavity: 89%

Intermediate Insulation and Framing Fractions:
Intermediate ceiling insulation and framing assumes tapering of insulation depth around the perimeter with resultant decrease in thermal resistance. An increased R-value is assumed in the center of the ceiling due to the effect of piling leftover insulation.
Framing: 9%
Insulated cavity: 91%

Advanced Insulation and Framing Fractions:
Advanced ceiling insulation and framing assumes full and even depth of insulation extending to the outside edge of exterior perimeter of the ceiling.
Framing: 7%
Insulated cavity: 93%

TABLE ~~A402.1.7~~ A402.1.5.3
CEILING COMPONENT DEFAULT VALUES

Component	Default Value	
Interior Air Film R-Value	0.61	
Drywall Layer R-Value	0.45	
Cavity Layer R-Values	Insulation: As Specified	Framing: R-1.25 per inch of wood
Standard Reference Design Insulation / Framing Fraction	Insulation: 93%	Framing: 7%
Proposed Design Default Insulation / Framing Fraction	Insulation: ~~89~~ 91%	Framing: ~~11~~ 9%
Exterior Air Film R-Value	0.61	

A402.2.1 Ceilings with attic spaces. When Section A402.1.1 would require R-38 in the ceiling, R-30 shall be deemed to plate at the eaves. Similarly R-38 shall be deemed to satisfy the requirement for R-49 or higher wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves.

A402.2.2 Ceilings without attic spaces. Where Section A402.1.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section A402.1.1 shall be limited to 500 square feet (46 m2) or 20% of the total insulated ceiling area, which ever is less.

~~AIR INFILTRATION SEALING TO PREVENT THERMAL BYPASSES~~

A402.4.1 (Supp) Building thermal envelope. The building thermal envelope shall be durably sealed to limit infiltration and prevent thermal bypasses. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The thermal envelope, including insulation and air barriers, shall be inspected in accordance with Sections A402.4.1.1 through A402.4.1.6.

~~**A402.4.1.1 Walls Adjoining Exterior Walls or Unconditioned Spaces.** Fully insulated wall in substantial contact with air barrier at both interior and exterior, or for Climate Zones 1 thru 3, sealed exterior air barrier aligned with fully supported insulation. The following areas shall meet these requirements: wall behind shower/tub, wall behind fireplace, insulated attic slopes for un-vented attic spaces, attic knee walls, skylight shaft walls, wall adjoining porch roof, staircase walls, double walls.~~

~~**A 402.4.1.2 Floors Between Conditioned and Exterior Spaces.** An air barrier shall be installed at any exposed insulation edges. Insulation shall be installed to maintain substantial contact w/ sub-floor above and air barrier below. The following areas shall meet these requirements: Insulated floor above un-conditioned and semi-conditioned space.~~

~~**A 402.4.1.3 Shafts.** Openings and gaps to unconditioned space shall be fully sealed with an air barrier. The following areas shall meet these requirements: duct, piping and flue shafts and associated penetrations.~~

~~**A 402.4.1.4 Attic and Ceiling Interface.** Attic penetrations and dropped ceilings shall include a full interior air barrier aligned with insulation with any gaps fully sealed. Insulation shall fit snugly in opening and the opening air barrier shall be fully gasketed. The following areas shall meet these requirements: attic access panel, attic drop-down stair, dropped ceiling/soffit, recessed lighting fixtures, whole-house fan.~~

~~**A 402.4.1.5 Common Walls Between Dwelling Units.** Gap between drywall shaft wall (common wall) and structural framing between units shall be sealed at all exterior boundary conditions.~~

~~**A 402.4.1.6 Gaps and Penetrations.** Gaps and penetrations in the thermal envelope of the home shall be sealed and insulated. The following areas shall meet these requirements: the perimeters of windows, doors, skylights, and utility penetrations, hose bibs, exterior electrical outlets and light fixtures.~~

A402.4.2 Air sealing and insulation. Building envelope air tightness and insulation installation shall be demonstrated to comply with the following requirements established by Section A402.4.2.1 ~~or~~ and A402.4.2.2:

A402.4.2.1 Performance testing. Building envelope tightness shall be tested to have an air leakage less than 0.00036 SLA when tested with a blower door at a pressure of 50 pascals (0.2 inch w.g.). Testing shall occur any time after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances and sealing thereof. Where required by the code official, an approved party independent from the builder shall conduct the building envelope tightness test. A written test report showing compliance shall be provided to the code official.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed;
2. Dampers shall be closed, but not sealed; including exhaust, intake, makeup air, back draft, and flue dampers;
3. Interior doors connecting conditioned spaces shall be open; doors connecting to unconditioned spaces closed but not sealed;
4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling system(s) shall be turned off;
6. HVAC duct s systems shall be sealed~~;~~ and supply and return registers shall not be sealed.

A402.4.2.2 Visual inspection requirement. Building envelope tightness and insulation installation shall be field verified to meet the criteria in Table A402.4.2. Where required by the code official, an approved party independent from the builder and the installer of the insulation, shall inspect the air barrier and insulation; in such case, a written inspection report, including a checklist demonstrating compliance shall be provided to the code official before interior finish materials are applied.

(Renumber subsequent sections)

TABLE A402.4.2
AIR BARRIER AND INSULATION INSPECTION

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air permeable insulation is not used as a sealing material. Air permeable insulation is inside of an air barrier.
Ceiling / attic	Air barrier in any dropped ceiling / soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are sealed and insulated. Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.
Crawlspace walls	Insulation is permanently attached to walls. Exposed earth in unvented crawlspaces is covered with class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls, and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by spayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are airtight, IC rated, and sealed to drywall.
Plumbing and Wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower / tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical / phone box on exterior walls	Air barrier extends behind boxes or an air sealed type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

A402.4.3 Fireplaces. New wood-burning fireplaces shall have gasketed doors and outdoor combustion air.

(Renumber subsequent sections)

~~MINIMUM INSULATION REQUIREMENTS~~

A402.7 Minimum opaque envelope requirements (Mandatory). The thermal requirements for opaque envelope components shall not be less than the requirements in Table A402.7 when determining alternatives to the R-values in Table A402.1.1 under Sections A402.1.3, A402.1.4, or A404.

TABLE A402.7
MINIMUM INSULATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	STEEL FRAME WALL ~~CONTINUOUS~~ R-VALUE [c]	FLOOR R-VALUE	BASEMENT WALL R-VALUE	SLAB R-VALUE & DEPTH	CRAWL SPACE WALL R-VALUE
1	25	11	0	R-11+3	11	0	0	0
2	25	11	3	R-11+3	11	0	0	0
3	25	11	4	R-11+3	13	0	0	0
4 except Marine	30	11	4	R-11+3	13	5/11 [b]	5, 2ft	5/11 [b]
5 and Marine 4	30	13	5	R-13+5, or R-15+4, or R-21+3	19	5/11 [b]	5, 2ft	5/11 [b]
6	38 [a]	13	13	R-13+5, or R-15+4, or R-21+3	19	5/11 [b]	10, 2ft	5/11 [b]
7 and 8	38 [a]	19	15	R-13+9, or R-19+8, or R-25+7	19	5/11 [b]	10, 2ft	5/11 [b]

a. R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves or the design of the roof/ceiling assembly does not allow sufficient space for the required insulation. This reduction of insulation shall be limited to 500 square feet (46 m^2) of ceiling area.
b. The first R-value applies to continuous insulation, the second to framing cavity insulation; either insulation configuation meets the requirement.
c. Cavity insulation R-value is listed first, followed by continuous insulation R-value.

~~IMPROVEMENTS TO DUCT DISTRIBUTION SYSTEMS EFFICIENCY~~

A403.2.2 Sealing. All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3 of the *International Residential Code*. A written test report showing compliance with the duct tightness tests below shall be provided to the code official. The report shall include the test type and tested leakage in CFM per 100 ft^2 of conditioned floor area at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Where required by the code official, an approved party independent from the builder shall conduct the test. Duct tightness shall be verified by either of the following:

1. Post-construction test: Leakage to outdoors shall be less than or equal to 8 CFM per 100 ft^2 of conditioned floor area or a total leakage less than or equal to 12 CFM per 100 ft^2 of conditioned floor area. 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 6 CFM per 100 ft^2 of conditioned floor area. All register boots 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 4 CFM per 100 ft^2 of conditioned floor area.

Exceptions: Duct tightness test is not required if the air handler and all ducts are located within conditioned space.

~~**A403.2.4 Distribution System Efficiency.** Ducts shall be located completely within the building thermal envelope or achieve an equivalent distribution efficiency of 0.88 or greater.~~

~~**Exceptions:**~~

1. ~~In climate zones 1-2, duct systems that supply air from cooling equipment with an efficiency that exceeds prevailing federal minimum standards by at least 15%;~~
2. ~~In climate zone 3, duct systems that supply air from either cooling equipment or heating equipment with an efficiency that exceeds prevailing federal minimum standards by at least 15%~~
3. ~~In climate zones 4-8, duct systems that supply air from heating equipment with an efficiency that exceeds prevailing federal minimum standards by 15%.~~

~~SERVICE WATER HEATING EFFICIENCY IMPROVEMENTS~~

A403.4 Service Water Heating. Service hot water piping shall be installed in accordance with Sections A403.4.1 through A403.4.3.

A403.4.1 Insulation. All Service Hot Water piping shall be insulated to at least R-2 for pipes sized 1" in diameter or less and R-4 for pipes larger than 1" in diameter for the distance between the Service Water Heater to within 5 feet of each fixture connected to the hot water pipe.

Exception: Hot water distribution systems not located below ground or located in a mass floor or mass wall in contact with ground that supply hot water from ~~Service Water Heating systems with an efficiency that exceeds prevailing federal minimum standards by at least 15% for~~ condensing gas service water heating equipment, from instantaneous service electric or gas water heating equipment ~~and achieve efficiency of at least 1.0 EF for~~ or from heat pump electric service water heating equipment.

A403.4.2 Stub-in for Solar Water. All Service Water Heating distribution systems shall have a stub-in connection point for future Solar Hot Water Systems in an accessible location within 5 feet of the roof.

Exception: Distribution systems that supply hot water in climate zones 6, 7 and 8. ~~from Service Water Heating systems with an efficiency that exceeds prevailing federal minimum standards by at least 15% for gas service water heating equipment and achieve efficiency of at least 1.0 EF for electric service water heating equipment.~~

A403.4.3 Circulating hot water systems. All circulating service hot water piping shall be insulated to R-2 for pipes sized 1" in diameter or less and R-4 for pipes larger than 1" in diameter. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

~~IMPROVED EQUIPMENT SIZING REQUIREMENTS~~

A403.6 Equipment sizing. Heating and cooling equipment shall be sized in accordance with ~~Section M1401.3 of the International Residential Code, and~~ this section and Table A403.6.

~~**A403.6.1 Oversizing Limits.** The maximum oversizing limit for air conditioners and air-source and ground-source heat pumps is 15% with the following two exceptions: single-speed air-source and ground-source heat pumps in buildings with heating loads that exceed cooling loads have a limit of 25%, and multi-stage heat pumps do not have a strict limit, but shall be sized to allow adequate humidity control in the cooling mode. The maximum oversizing limit for gas, oil or propane heating equipment is 40%.~~

TABLE A403.6

UNIT	MAXIMUM OVERSIZING PERCENTAGE [1,2]	CLIMATE ZONE	MINIMUM EFFICIENCY & TEST PROCEDURES
Air Conditioners	15%	ALL	Table 503.2.3(1)
Multi-speed[3] Air-Source Heat Pumps and Ground-Source Heat Pumps	15%	ALL	Table 503.2.3(2)
Single -speed Air-Source Heat Pumps and Ground Source Heat Pumps	15% 25%	1-3 ---- 4-8	Table 503.2.3(2) or Table 503.2.3(3)
All fuel-fired heating appliances	40%	ALL	Table 503.2.3(4) or Table 503.2.3(5)

Notes: ~~**A403.6.2 Operating conditions.** The following operating conditions shall be used in the sizing calculations and verified by the code official:~~

1. Equipment shall be sized in accordance with ACCA Manual J:
   a. Indoor and outdoor coils shall be matched for size;
   b. Outdoor temperatures shall be the 99.0% and 1.0% design temperatures as published in the ASHRAE Handbook of Fundamentals for the ~~home's location or~~ most representative city for which design temperature data are available;
   c. ~~2.~~ Indoor temperatures shall be 75 F for cooling and ~~70~~ 72 F for heating;
   d. ~~3.~~ Infiltration rate shall be ~~selected as "tight", or the equivalent term~~ assumed as 0.00036 Specific Leakage Area (SLA).
2. ~~**403.6.3 Specifying equipment.** Specification of~~ Once the appropriate equipment size is determined, if that specific size does not exist, the next larger size of ~~available~~ manufactured ~~size~~ equipment shall be acceptable, regardless of the percentage listed. ~~In addition, indoor and outdoor coils shall be matched in accordance with ARI Standard 210/240.~~
3. Multi-speed units shall be permitted to exceed the listed percentage only to the cooling capacity necessary to control humidity levels.

~~RESIDENTIAL LIGHTING EQUIPMENT EFFICIENCY~~

SECTION A404 (Supp)
ELECTRICAL POWER AND LIGHTING SYSTEMS

A404.1 **(Supp)** ~~**Interior lighting power (Prescriptive).** Lighting in spaces other than dwelling units, e.g. common areas, shall be high efficacy luminaires or shall comply with the interior lighting power requirements in Section 505.5~~
~~**Exception:** Dwelling units.~~

~~**A404.1 Dwelling unit interior and exterior lighting power (Prescriptive).** 50% of all dwelling unit interior and exterior hard-wired lighting sockets shall be a qualifying light fixture. All exterior lighting equipment shall be a qualifying light fixture or shall comply with the exterior lighting power requirements of Section 505.7~~

~~**Exceptions:**~~
~~1. Swimming pool lighting systems~~
~~2. Landscape lighting systems~~

A404.2 **Lighting equipment** ~~**(Supp) Interior lighting power (Prescriptive).**~~ A minimum of fifty percent of the lamps in permanently installed lighting fixtures shall be high efficacy lamps. ~~Lighting in spaces other than dwelling units, e.g. common areas, shall be high efficacy luminaires or shall comply with the interior lighting power requirements in Section 505.5.~~

~~EFFICIENCY IMPROVEMENTS TO SIMULATED PERFORMANCE ALTERNATIVE~~

SECTION A404
SIMULATED PERFORMANCE ALTERNATIVE
(Performance)

Section A404.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, lighting, and service water heating energy only.

TABLE A404.5.2(1) (Supp)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame Gross Area: same as proposed U-Factor: from Table A402.1.3 Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified[a] As proposed As proposed
Basement and crawl-space walls	Type: same as proposed Gross Area: same as proposed U-Factor: from Table A402.1.3, with insulation layer on interior side of walls	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified[a]
Above-grade floors	Type: wood frame Gross Area: same as proposed U-Factor: from Table A402.1.3	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified[a]
Ceilings	Type: wood frame Gross Area: same as proposed U-Factor: from Table A402.1.3	As proposed As proposed As proposed, assuming gaps/missing insulation equal to 5%, unless otherwise verified[a]
Doors	Area: 40 ft^2 Orientation: North *U*-Factor: same as fenestration from Table A402.1.3	As proposed As proposed As proposed
Glazing ~~Fenestration~~[b]	Total area[c] = (a) The proposed glazing ~~fenestration~~ area; where the proposed glazing ~~fenestration~~ area is less than 15% of the conditioned floor area (b) 15% of the conditioned floor area; where the proposed glazing ~~fenestration~~ 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 A402.1.1 SHGC: From Table A402.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used. ~~For glazing, which shall equal the total area as defined above minus 40 ft², from Table 402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used; for opaque doors, which shall equal 40 ft², SHGC = 0 for all climates, equally distributed to four cardinal compass orientations.~~ Interior shade fraction: Summer (all hours when cooling is required) = 0.85 ~~0.90~~ Winter (all hours when heating is required) = 0.85 ~~0.90~~ External shading: none	As proposed As proposed As proposed As proposed Same as standard reference design[d] As proposed
Air Exchange Rate	Specific Leakage Area (SLA)[e] = 0.00036 assuming no energy recovery. ~~0.00015 combined with the mechanical ventilation rate, which shall be 0.01 x CFA + 7.5 x (Nbr+1)~~ ~~where:~~ ~~CFA = conditioned floor area~~ ~~Nbr = number of bedrooms~~ ~~and assuming continuous balanced ventilation using a energy/heat recovery ventilator with a recovery efficiency of 76%~~ [g]	Specific Leakage Area (SLA)[d] = the tested leakage for the proposed home and ~~For residences that are not tested, 0.00060 SLA assuming no energy recovery~~ the tested value shall be in accordance with the ASHRAE 119, Section 5.1 and the SLA shall be: 1. For residences without mechanical ventilation ~~that are tested in accordance with ASHRAE 119, Section 5.1,~~ the measured air exchange rate[e] but not less than 0.35 ACH 2. For residences with mechanical ventilation ~~that are tested in accordance with ASHRAE 119, Section 5.1,~~ the measured air exchange

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
		rate[e] combined with the mechanical ventilation rate, [f] which shall not be less than 0.01 x CFA + 7.5 x (Nbr+1) where: CFA = conditioned floor area Nbr = number of bedrooms
Internal Gains	IGain = 17,900 + 23.8 x CFA + 4104 x Nbr + $\Delta IG_{lighting}$ (Btu/day per dwelling unit) Where $\Delta IG_{lighting}$ represents the reduced internal gains from efficient lighting as defined by the lighting building component.	IGain = 17,900 + 23.8 x CFA + 4104 x Nbr + $\Delta IG_{lighting}$ (Btu/day per dwelling unit) Where $\Delta IG_{lighting}$ represents the reduced internal gains from efficient lighting as defined by the lighting building component.
Heating systems[i, j]	As proposed ~~Fuel type: same as proposed design~~ ~~Efficiencies:~~ ~~Electric: air source heat pump with efficiency as proposed, unless the proposed is greater than 15% above the federal minimum, in which case it shall be 15% above the federal minimum.~~ ~~Nonelectric furnaces: natural gas furnace with efficiency as proposed, unless the proposed is greater than 15% above the federal minimum, in which case it shall be 15% above the federal minimum~~ ~~Nonelectric boilers: natural gas boiler with efficiency as proposed, unless the proposed is greater than 15% above the federal minimum, in which case it shall be 15% above the federal minimum~~ Capacity: sized in accordance with Section M1401.3 of the *International Residential Code*	As proposed ~~As proposed~~ ~~As proposed~~ ~~As proposed~~ ~~As proposed~~
Cooling systems[i, k]	As proposed ~~Fuel type: Electric~~ ~~Efficiency: as proposed, unless the proposed efficiency is greater than 15% above the prevailing federal minimum efficiency, in which case it shall be 15% above the federal minimum.~~ Capacity: sized in accordance with Section M1401.3 of the *International Residential Code*	As proposed ~~As proposed~~ ~~As proposed~~
Service Water Heating[i, l]	As proposed ~~Fuel type: same as proposed design~~ ~~Efficiency: as proposed, unless the proposed efficiency is greater than 15% above the prevailing federal minimum efficiency, in which case it shall be 15% above the federal minimum.~~ Use: Same as proposed design	As proposed ~~As proposed~~ Use: gal/day=30 + (10 x N_{br})
Thermal distribution systems	A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be the applicable maximum rate from Section A403.2.2.	~~A thermal distribution system efficiency (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies, except as specified by Table 404.5.2(2)~~ As tested or as specified in Table A404.5.2(2) if not tested.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature set point = 72 ~~70~~ °F	Same as standard reference
~~Lighting~~	~~kWh/yr = (455 + 0.80 * CFA) + □kWh/yr~~ ~~where:~~ ~~□kWh/yr = [29.5 – 0.5189*CFA *50% –295.12*50% + 0.0519*CFA]~~ ~~Internal gains in the Standard Reference Design shall be reduced by 90% of the impact from efficient lighting, calculated in btu/day using the following equation:~~ ~~$\Delta IG_{lighting}$ = - 0.90 * ΔkWh/yr * 10^6 / 293 / 365~~	~~kWh/yr = (455 + 0.80 * CFA) + □kWh/yr~~ ~~where:~~ ~~□kWh/yr = [29.5 – 0.5189*CFA*FL% – 295.12*FL% + 0.0519*CFA]~~ ~~FL% = the ratio of Qualifying Light Fixtures to all light fixtures in Qualifying Light Fixture Locations.~~ ~~The Proposed Design shall not have FL% more than 50% from CFL.~~ ~~Internal gains in the Proposed Design shall be reduced by 90% of the impact from efficient lighting, calculated in btu/day using the following equation:~~ ~~$\Delta IG_{lighting}$ = 0.90 * ΔkWh/yr * 10^6 / 293 / 365~~

a. Insulation installation, including percent of insulation missing and insulation substantially filling cavity and, shall be determined and documented by an independent party approved by the code official.
b. Glazing shall be defined as sunlight-transmitting fenestration, including the area of sash, curbing or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight-transmitting fenestration assemblies in walls bounding conditioned basements. For doors where the sunlight-transmitting opening is less than 50% of the door area, the glazing area is the sunlight transmitting opening area. For all other doors, the glazing area is the rough frame opening area for the door including the door and the frame.
c. For residences with conditioned basements, R-2 and R-4 residence and townhouses, the following formula shall be used to determine glazing area:
$AF = A_s \times FA \times F$
Where:
AF = Total glazing area.
A_s = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
And where:
Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
d. For fenestrations facing within 15 degrees (0.26 rad) of true south that are directly coupled to thermal storage mass, the winter interior shade fraction shall be permitted to be increased to 0.95 in the proposed design.
e. Where Leakage Area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where:
SLA = L/CFA
where L and CFA are in the same units.
f. Tested envelope leakage shall be determined and documented by an independent party approved by the code official. Hourly calculations as specified in the 2001 ASHRAE Handbook of Fundamentals, Chapter 26, page 26.21, Equation 40 (Sherman-Grimsrud model) or the equivalent shall be used to determine the energy loads resulting from infiltration.
g. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE Handbook of Fundamentals page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE Handbook of Fundamentals, page 26.19 for intermittent mechanical ventilation.
h. Thermal Storage Element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
i. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
j. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design. For electric heating systems, the prevailing federal minimum efficiency air-source heat pump shall be used for the standard reference design.
k. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
l. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum Energy Factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

TABLE A404.5.2(2)
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION:	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	~~0.80~~ --	0.95
Untested distribution systems entirely located in conditioned space [c]	0.88	1.00
~~Proposed “reduced leakage” with entire air distribution system located in the conditioned space [d]~~	~~0.96~~	~~--~~
~~Proposed “reduced leakage” air distribution system with components located in the unconditioned space~~	~~0.88~~	~~--~~
“Ductless” systems [d] ~~[e]~~	1.00	--

a. through c. (No change to current text)
~~d. Proposed “reduced leakage” shall mean leakage to outdoors not greater than 3 cfm per 100 ft2 of conditioned floor area and total leakage not greater than 9 cfm per 100 ft2 of conditioned floor area at a pressure differential of 0.02 inches w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Total leakage of not greater than 3 cfm per 100 ft2 of conditioned floor area at a pressure difference of 0.02 inches w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure, shall be deemed to meet this requirement without measurement of leakage to outdoors. This performance shall be specified as required in the construction documents and confirmed through field-testing of installed systems as documented by an approved independent party.~~
~~e.~~ d. Ductless systems may have forced airflow across a coil but shall not have any ducted airflows external to the manufacturer’s air handler enclosure.

<u>CHAPTER A6</u>
<u>REFERENCED STANDARDS</u>

<u>Copy Chapter 6 of the 2006 IECC (as amended by the Supplement) in its entirety and revise as follows:</u>

Add the following reference to Chapter 6:
ACCA Manual J 2006

Commenter's Reason: EC154 is part of the EECC's efforts to comprehensively seek a 30% improvement in the *IECC.* EC154 creates an appendix that offers an option for localities that want to adopt a more advanced code than the *IECC*.

EC154 begins with the proposed modification contained in EC14, but also includes the more advanced energy efficiency proposals made by EECC that have been removed from EC14 and additional improvements EECC has identified as a result of participating in this process. Based on the comments made as to EECC's appendix approach in Palm Springs, we have modified the appendix approach to consist of a complete set of alternate residential energy chapters available for voluntary adoption. By taking this approach, there is no need to attempt to match up the appendix provisions with those proposals that are adopted in the actual IECC, since the appendix will consist of a complete stand-alone residential energy chapter (along with complete chapters of definitions and referenced standards).

The proposed modification to EC154 duplicates the provisions of the proposed modification to EC14 with the following specific exceptions intended to further improve the energy efficiency of the appendix:

1. Improved Wall insulation product-neutral improvements in each climate.
2. U-factors recalculated for the modified R-values and advanced framing fractions.
3. Retained the minimum insulation requirement table as in the original EC154.
4. The fenestration U-factors in climate zones 6 - 8 modified to 0.32 to be consistent with U-factors in EECC's public comment modification to EC21.
5. Utilizes the 0.25 SHGC requirements for climate zones 1-3 as set forth in the original EC154.
6. Include the stub-in for solar water with a climate based exception.
7. Included the air sealing inspection requirement based on the EC-64.

This public comment to EC154 is a comprehensive solution that is both cost effective and allows for significant energy savings for localities that adopt it as code.

Final Action: AS AM AMPC____ D