

**Appliance Standards and Rulemaking Federal Advisory Committee**  
*Manufactured Housing Working Group*  
Term Sheet  
October 31, 2014

**1. Background**

On June 13, 2014, the U.S. Department of Energy (DOE) issued a Notice of Intent to establish a negotiated rulemaking working group (WG) under the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) in accordance with the Federal Advisory Committee Act (FACA) and the Negotiated Rulemaking Act (NRA) to negotiate proposed federal standards for energy efficiency in manufactured homes. *See* 79 FR 33873. The stated purpose of the WG was to discuss and, if possible, reach consensus on a proposed rule for the energy efficiency of manufactured homes, as authorized by section 413 of the Energy Independence and Security Act of 2007 (EISA).

On July 16, 2014, DOE announced the members of the WG, which consisted of representatives of parties with a defined stake in the outcome of the proposed standards. *See* 79 FR 41456. Specifically, the WG consisted of 22 members, including one member from ASRAC and one DOE representative (see Appendix A). The WG met in-person during six sets of meetings held on August 4-5, August 21-22, September 9-10, September 22-23, October 1-2, and October 23-24. *See* 79 FR 48097 and 79 FR 59154.

The WG successfully reached consensus on proposed energy efficiency standards for manufactured housing. This document includes the WG's recommendations to ASRAC on the proposed standards.

**2. Applicable Aspects of the 2015 IECC**

**Recommendation**

The WG reviewed the 2015 International Energy Conservation Code (IECC) for residential buildings for applicability to manufactured housing over the course of the six public meetings. The WG identified sections of the 2015 IECC that were not applicable or that the WG modified. Consensus was reached on these items, as recorded in Appendix B.

**Vote:** Consensus<sup>1</sup> (19-yes; 1-no; 2-abstain<sup>2</sup>): October 24, 2014.

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<sup>1</sup> For purposes of this WG, “consensus” was defined as at least a two-thirds “supermajority” in favor of the recommendation. Votes in favor of a recommendation included “thumbs-up” and “thumbs-sideways.” Votes against a recommendation were indicated with a “thumbs-down.”

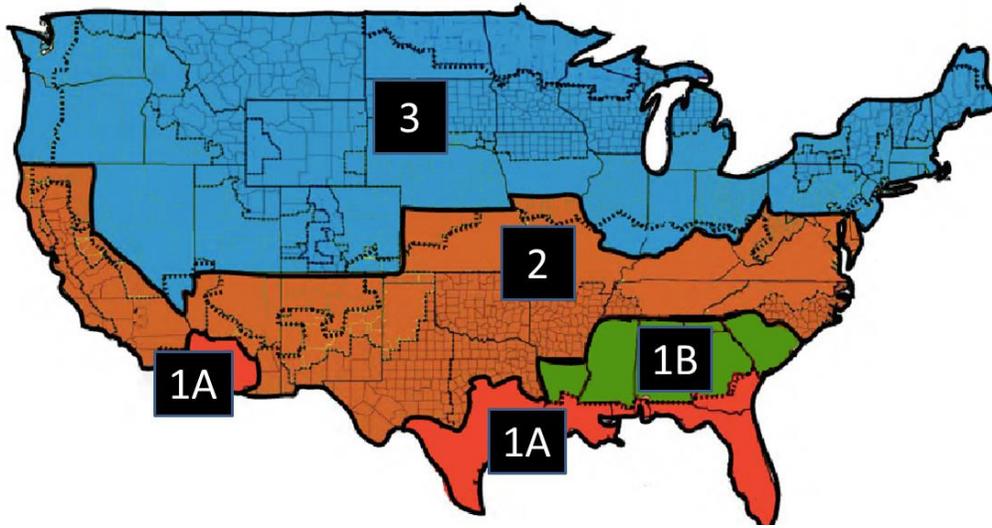
<sup>2</sup> Some recommendations did not receive votes from all 22 members, either due to a decision to abstain from voting or absence from the meeting.

### 3. Climate Zones

#### 3.1. Recommendation

The WG recommends that the energy efficiency standards be based on the four climate zones in Figure 3.1.

**Figure 3.1 Climate Zone Map**



**Note:** Consensus (20-yes; 1-no; 1-abstain): October 23, 2014.

\* The WG did not consider Alaska, Hawaii, and U.S. Territories. DOE will determine zoning of those states and territories when it develops a Notice of Proposed Rulemaking (NPR).

#### 3.2. Recommendation

The WG recommends using the naming convention of zone 1A, 1B, 2, and 3.

**Note:** Consensus (20-yes; 0-no; 2-abstain): October 24, 2014.

### 4. Building Thermal Envelope Pathways to Compliance

#### Recommendation

The WG recommends allowing both a prescriptive path option (see section 5) and a performance path option (see section 6) to ensure improved energy efficiency of a manufactured home's building thermal envelope. The prescriptive path would specify a portfolio of specific building thermal envelope energy efficiency measures (e.g., R-30 ceiling insulation). The performance path would specify an overall building thermal envelope  $U$ -value ( $U_o$ ). Both building thermal envelope compliance pathways would also include the mandatory requirements summarized in section 7.

**Vote:** Consensus (20-yes; 0-no; 2-abstain): October 2, 2014.

## 5. Building Thermal Envelope Requirements: Prescriptive Path Option

### Recommendation

The WG recommends the prescriptive measures associated with the 4 climate zones outlined in Table 5.1. These measures would be the same for manufactured homes of all sizes (e.g., single- and multi-section manufactured homes).

**Table 5.1 Building Thermal Envelope Prescriptive Requirements**

| Climate Zone | Ceiling (R-value) | Wall (R-value) | Floor (R-value) | Window (U-value) | Skylight (U-value) | Door (U-value) | Glazed Fenestration (SHGC) |
|--------------|-------------------|----------------|-----------------|------------------|--------------------|----------------|----------------------------|
| 1A           | 30                | 13             | 13              | 0.35             | .75                | 0.40           | 0.25                       |
| 1B           | 30                | 13             | 13              | 0.35             | .75                | 0.40           | Pending DOE Analysis*      |
| 2            | 30                | 21             | 19              | 0.35             | .55                | 0.40           | Pending DOE Analysis*      |
| 3            | 38                | 21             | 30              | 0.32             | .55                | 0.40           | No Rating                  |

\*The WG did not reach consensus on prescriptive specifications for SHGC in climate zones 1B and 2, and has recommended that DOE determine these values after further analysis when it develops a NOPR.

**Vote:** Consensus (20-yes; 1-no; 1-abstain): October 23, 2014.

### 5.1. Recommendation

The WG recommends the following footnotes apply to the prescriptive requirements listed in Table 5.1.

1. For conversion between units of length: 1 foot = 304.8 mm.
2. Table 5.1 includes the minimum R-values required to comply with DOE’s proposed standards. U-value and SHGC specifications reflect maximum values.
3. The SHGC column of Table 5.1 applies to all glazed fenestration. Exception: Skylights may be excluded from building thermal envelope glazed fenestration SHGC requirements where the SHGC for such skylights does not exceed 0.30.
4. The floor R-value column assumes R-21 batt + R-14 blanket values to account for compression areas in the floor in climate zone 3.
5. The wall R-value column assumes a minimum truss heel height of 5.5 inches at the outside face of each exterior wall.
6. Each R-value column reflects the insulation manufacturers’ published values. Uniform insulation thickness would not be mandatory as long as the required volume of insulation is installed with uniform density.

**Vote:** Consensus (19-yes; 1-no; 2-abstain) October 24, 2014.

### 5.2. Recommendation

The WG recommends DOE complete further analysis to determine  $U$ -values for use as an alternative to the  $R$ -values listed in Table 5.1. Under this alternative  $U$ -value approach to the prescriptive path option of ensuring improved energy efficiency of a manufactured home’s building thermal envelope, a manufacturer would need to comply with the window, skylight, and door  $U$ -values and the glazed fenestration SHGC specifications included in Table 5.1.

**Table 5.2  $U$ -Value Alternative for Ceiling, Wall, and Floor**

| Climate Zone | Ceiling ( $U$ -value) | Wall ( $U$ -value)    | Floor ( $U$ -value)   |
|--------------|-----------------------|-----------------------|-----------------------|
| 1A           | Pending DOE Analysis* | Pending DOE Analysis* | Pending DOE Analysis* |
| 1B           | Pending DOE Analysis* | Pending DOE Analysis* | Pending DOE Analysis* |
| 2            | Pending DOE Analysis* | Pending DOE Analysis* | Pending DOE Analysis* |
| 3            | Pending DOE Analysis* | Pending DOE Analysis* | Pending DOE Analysis* |

\* The WG did not reach consensus on the  $U$ -values for Table 5.2 and has recommended DOE determine these values after further analysis when it develops a NOPR.

**Vote:** Consensus (20-yes; 1-no; 1-abstain): October 24, 2014.

## 6. Building Thermal Envelope Requirements: $U_o$ Performance Path Option

### 6.1. Recommendation

The WG recommends the  $U_o$  values associated with the 4 climate zones in Table 6.1, and in connection with the number of sections in a manufactured home. The SHGC requirement shall be met in addition to  $U_o$  compliance. An area weighted average SHGC of windows, skylights, and doors more than 50 percent glazed shall satisfy the glazed fenestration SHGC requirements of Table 5.1.

**Vote: (recommendation text):** Consensus (19-yes; 1-no; 2-abstain): October 24, 2014.

**Table 6.1  $U_o$  Values for Performance Path**

| Climate Zone | Single-Section $U_o$ | Multi-Section $U_o$ |
|--------------|----------------------|---------------------|
| 1A           | 0.087                | 0.084               |
| 1B           | 0.087                | 0.084               |
| 2            | 0.070                | 0.068               |
| 3            | 0.059                | 0.056               |

**Vote (recommendation table):** Consensus (20-yes; 1-no; 1-abstain): October 23, 2014.

### 6.2. Recommendation

The WG recommends that the calculation of  $U_o$  follow the Battelle calculation method.<sup>3</sup> The Battelle calculation method produces an area-weighted average overall  $U$ -value for a home based on the thermal qualities and areas of material assemblies used in the home's construction.

**Vote:** Consensus (20-yes; 0-no; 2-abstain): October 24, 2014.

## 7. Other Mandatory Requirements

The WG recommends that the proposed regulations include the following requirements for all manufactured homes, regardless of the building thermal envelope compliance path selected:

### 7.1. Recommendation

The following requirements would establish compliant building thermal envelope air sealing. These proposed requirements are intended to provide a prescriptive path for reaching envelope tightness of 5 air changes per hour (ACH) when depressurized to 50 Pascals (Pa).

All manufactured homes would be required to be sealed against air leakage at all joints, seams, and penetrations associated with the building thermal envelope in accordance with the manufacturer's installation instructions, including ensuring that:

1. A continuous air barrier is established upon installation of all building thermal envelope (i.e., ceiling, walls, doors, and floor) opaque components.
2. Mating line surfaces (i.e., floor, exterior walls, and ceiling) are equipped with a continuous, durable gasket.
3. Gaps and penetrations in the ceilings, floors, and exterior surfaces of walls would be sealed with caulk, foam or gasket, or other suitable material. The following gaps and penetrations, at a minimum, would require sealing: ducts, flue shafts, plumbing, piping, electrical wiring, bathroom and kitchen exhaust fans, recessed lighting fixtures adjacent to unconditioned space, and light tubes adjacent to unconditioned space.
4. Rough openings around windows and exterior doors are sealed with caulk or foam.
5. Attic access panels and drop-down stairs are equipped with gaskets (i.e., not caulked) to produce a continuous air seal.
6. Duct system register boots that penetrate the building thermal envelope and/or air infiltration barrier are sealed to the air barrier or interior finish materials.
7. Sealing methods between dissimilar materials allow for differential expansion and contraction.

**Vote:** Consensus (15-yes; 2-no; 5-abstain): September 23, 2014

### 7.2. Recommendation

The WG recommends that duct leakage must be no greater than 4 cubic feet per minute (CFM) per 100 square feet of floor area at a 25 Pa test pressure.

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<sup>3</sup> Conner C. C., Taylor, Z. T. "Overall U-Values and Heating/Cooling Loads – Manufactured Homes." Pacific Northwest Laboratory. 1992.

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**Vote:** Consensus (19-yes; 0-no; 3-abstain): September 22, 2014

### **7.3. Recommendation**

All hot water pipes outside conditioned space would be required to be insulated to at least *R-3*. In addition, all hot water pipes from a water heater to a distribution manifold would be required to be insulated to at least *R-3*.

**Vote:** Consensus (17-yes; 0-no; 5-abstain): September 23, 2014

*This term sheet has been approved by the ASRAC manufactured housing working group by consensus (20-yes, 1-no; 1-abstain) on October 24, 2014.*

## **Appendix A: Working Group Members**

### Manufactured Housing Negotiated Rulemaking Working Group

#### **DOE and ASRAC Representatives**

Joseph Hagerman – Department of Energy

John Caskey - ASRAC, National Electrical Manufacturers Association

#### **Other Selected Members**

Bert Kessler - Palm Harbor Homes, Inc.

David Tompos - NTA, Inc.

Emanuel Levy - Systems Building Research Alliance

Eric Lacey - Responsible Energy Codes Alliance

Ishbel Dickens - National Manufactured Home Owners Association (NMHOA)

Keith Dennis - National Rural Electric Cooperative Association

Lois Starkey - Manufactured Housing Institute

Lowell Ungar - American Council for an Energy-Efficient Economy

Manuel Santana - Cavco Industries

Mark Ezzo - Clayton Homes, Inc.

Mark Weiss - Manufactured Housing Association for Regulatory Reform

Michael Lubliner - Washington State University Extension Energy Program

Michael Wade - Cavalier Home Builders

Peter Schneider - Efficiency Vermont

Richard Hanger - Housing Technology and Standards

Richard Potts - Virginia Department of Housing and Community Development

Rob Luter - Lippert Components, Inc.

Robin Roy - Natural Resources Defense Council

Scott Drake - East Kentucky Power Cooperative

Stacey Epperson - Next Step Network

## Appendix B: Applicable Aspects of the 2015 IECC

Overview:

Appendix B outlines the changes to the residential sections of the 2015 International Energy Conservation Code (IECC) discussed by the manufactured housing (MH) working group (WG). Each section is marked with a note in square brackets indicating the consensus action agreed to by the WG. The notes are listed and defined in Table 1 below.

**Table 1 Notation Descriptions**

| <b>Notation</b>                 | <b>Description</b>  |
|---------------------------------|---|
| Deleted by WG                   | Indicates the WG reached consensus that the section is not applicable to MH.  |
| Included by WG                  | Indicates the WG reached consensus that the section is applicable to MH and required no revisions.  |
| Revised the WG                  | Indicates the WG reached consensus that the section is applicable to MH but required revisions.   |
| Added by WG                     | Indicates the WG reached consensus on adding a new section.   |
| Deferred to DOE by WG           | Indicates the WG reached consensus that the section should be addressed by DOE in the Notice of Proposed Rulemaking (NOPR).   |
| Included in Concept by WG       | Indicates the WG reached consensus on the conceptual nature of the section. DOE will need to revise the exact text and consider impacts of other provisions of the term sheet when developing the NOPR. |
| Not Discussed by WG             | Indicates the WG did not discuss or reach consensus on the action for a section. DOE will need to determine how to address these sections in the NOPR.  |
| Deleted – Term Sheet Supersedes | Indicates sections that were directly superseded by items in the term sheet.  |

## IECC—RESIDENTIAL PROVISIONS

### CHAPTER 1 [RE] [Deleted by WG]

### CHAPTER 2 [RE] DEFINITIONS

**R201.1 Scope.** [Revised by WG] Unless stated otherwise, the following definitions are applicable to the Term Sheet.

**R201.2 Interchangeability.** [Included by WG] Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular.

**R201.3 Terms defined in other codes.** [Deleted by WG]

**R201.4 Terms not defined.** [Included by WG] Terms not defined by this chapter shall have ordinarily accepted meanings such as the context implies.

### SECTION R202 GENERAL DEFINITIONS

**ABOVE-GRADE WALL.** [Deleted by WG]

**ACCESSIBLE.** [Revised by WG] Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means

**ADDITION.** [Deleted by WG]

**AIR BARRIER.** [Included by WG] 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.

**ALTERATION.** [Deleted by WG]

**APPROVED.** [Deleted by WG]

**APPROVED AGENCY.** [Deleted by WG]

**AUTOMATIC.** Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see “Manual”).

**BASEMENT WALL.** [Deleted by WG]

**BUILDING.** [Deleted by WG]

**BUILDING SITE.** [Deleted by WG]

**BUILDING THERMAL ENVELOPE.** [Revised by WG] Exterior walls, floor, roof and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

**C-FACTOR (THERMAL CONDUCTANCE).** [Included by WG] The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces (Btu/h · ft<sup>2</sup> · °F) [W/(m<sup>2</sup> · K)].

**CIRCULATING HOT WATER SYSTEM.** [Included by WG] A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to fixtures and back to the water-heating equipment.

**CLIMATE ZONE.** [Included by WG] A geographical region based on climatic criteria as specified in this code.

**CODE OFFICIAL.** [Deleted by WG]

**COMMERCIAL BUILDING.** [Deleted by WG]

**CONDITIONED FLOOR AREA.** [Included by WG] The horizontal projection of the floors associated with the *conditioned space*.

**CONDITIONED SPACE.** [Included by WG] An area, room or space that is enclosed within the building thermal envelope and that is directly or indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by

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uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

**CONTINUOUS AIR BARRIER. [Revised by WG]** A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

**CONTINUOUS INSULATION (ci). [Included by WG]** Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the building envelope.

**CRAWL SPACE WALL. [Included by WG]** The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

**CURTAIN WALL. [Deleted by WG]**

**DEMAND RECIRCULATION WATER SYSTEM. [Included by WG]** A water distribution system where pump(s) prime the service hot water piping with heated water upon demand for hot water.

**DOE.** U.S. Department of Energy

**DUCT. [Included by WG]** A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

**DUCT SYSTEM. [Included by WG]** A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

**DWELLING UNIT. [Deleted by WG]ENERGY ANALYSIS. [Included by WG]** A method for estimating the annual energy use of the *proposed design* and *standard reference design* based on estimates of energy use.

**ENERGY COST. [Included by WG]** The total estimated annual cost for purchased energy for the building functions regulated by this code, including applicable demand charges.

**ENERGY SIMULATION TOOL. [Revised by WG]** A DOE *approved* software program or calculation-based methodology that projects the annual energy use of a building.

**ERI REFERENCE DESIGN. [Deleted by WG]**

**EXTERIOR WALL. [Revised by WG]** Walls that enclose conditioned space.

**FENESTRATION. [Included by WG]** Products classified as either *vertical fenestration* or *skylights*.

**FENESTRATION PRODUCT, SITE-BUILT. [Deleted by WG]**

**F-FACTOR. [Deleted by WG]**

**HEATED SLAB. [Deleted by WG]**

**HIGH-EFFICACY LAMPS. [Revised by WG]** 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; and
3. 40 lumens per watt for lamps 15 watts or less.

**HISTORIC BUILDING. [Deleted by WG]**

**INFILTRATION. [Included by WG]** The uncontrolled inward air leakage into a building caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density or both.

**INSULATED SIDING. [Included by WG]** A type of continuous insulation with manufacturer-installed insulating material as an integral part of the cladding product having a minimum *R*-value of R-2.

**INSULATING SHEATHING. [Included by WG]** An insulating board with a core material having a minimum *R*-value of R-2.

**LABELED.** The WG recommends using HUD language.

**LISTED.** The WG recommends using HUD language.

**LOW-VOLTAGE LIGHTING. [Included by WG]** Lighting equipment powered through a transformer such as a cable conductor, a rail conductor and track lighting.

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**HOME MANUFACTURER. [Added by WG]** Any person engaged in manufacturing or assembling manufactured homes, including any person engaged in importing manufactured homes for resale.

**MANUAL. [Included by WG]** Capable of being operated by personal intervention (see “Automatic”).

**PROPOSED DESIGN. [Deleted by WG]**

**RATED DESIGN. [Deleted by WG]**

**READILY ACCESSIBLE. [Deleted by WG]**

**REPAIR. [Deleted by WG]**

**REROOFING. [Deleted by WG]**

**RESIDENTIAL BUILDING. [Deleted by WG]**

**ROOF ASSEMBLY. [Deleted by WG]**

**ROOF RECOVER. [Deleted by WG]**

**ROOF REPAIR. [Deleted by WG]**

**ROOF REPLACEMENT. [Deleted by WG]**

**R-VALUE (THERMAL RESISTANCE). [Included by WG]** The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ( $h \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$ ) [ $(\text{m}^2 \cdot \text{K})/\text{W}$ ].

**SERVICE WATER HEATING. [Included by WG]** Supply of hot water for purposes other than comfort heating.

**SKYLIGHT.** Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal.

**SOLAR HEAT GAIN COEFFICIENT (SHGC). [Included by WG]** The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation that is then reradiated, conducted or convected into the space.

**STANDARD REFERENCE DESIGN. [Deleted by WG]**

**SUNROOM. [Deleted by WG]**

**THERMAL ENVELOPE. [Deleted by WG]**

**THERMAL ISOLATION. [Included by WG]** Physical and space conditioning separation from *conditioned space(s)*. The *conditioned space(s)* shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

**THERMOSTAT. [Included by WG]** An automatic control device used to maintain temperature at a fixed or adjustable set point.

**U-FACTOR (THERMAL TRANSMITTANCE). [Included by WG]** The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films ( $\text{Btu}/\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F}$ ) [ $\text{W}/(\text{m}^2 \cdot \text{K})$ ].

**VENTILATION. [Included by WG]** The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

**VENTILATION AIR. [Included by WG]** That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

**VERTICAL FENESTRATION. [Included by WG]** Windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of a least 60 degrees (1.05 rad) from horizontal.

**VISIBLE TRANSMITTANCE [VT]. [Deleted by WG]**

**WHOLE HOUSE MECHANICAL VENTILATION SYSTEM. [Included by WG]** An exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air with outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation rates.

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**ZONE. [Included by WG]** A space or group of spaces within a building with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained throughout using a single controlling device.

**CHAPTER 3 [RE]  
GENERAL REQUIREMENTS**

**SECTION R301**

**CLIMATE ZONES [Deleted – Term Sheet Supersedes]**

**SECTION R302**

**DESIGN CONDITIONS**

**R302.1 Interior design conditions. [Not Discussed by WG]** The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

**SECTION R303**

**MATERIALS, SYSTEMS AND EQUIPMENT**

**R303.1 Identification. [Not Discussed by WG]** Materials, systems, and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.

**R303.1.1 Building thermal envelope insulation. [Not Discussed by WG]** An R-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and R-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled R-value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and R-value of installed thickness shall be listed on the certification. For insulated siding, the R-value shall be labeled on the product’s package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

**R303.1.1.1 Blown or sprayed roof/ceiling insulation. [Not Discussed by WG]** The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m<sup>2</sup>) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed R-value shall be listed on certification provided by the insulation installer.

**R303.1.2 Insulation mark installation. [Not Discussed by WG]** Insulating materials shall be installed such that the manufacturer’s R-value mark is readily observable upon inspection.

**R303.1.3 Fenestration product rating. [Not Discussed by WG]** U-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100.

**Exception:** Where required, garage door U-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory, and labeled and certified by the manufacturer.

Products lacking such a labeled U-factor shall be assigned a default U-factor from Table R303.1.3(1) or R303.1.3(2). The solar heat gain coefficient (SHGC) and visible transmittance (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table R303.1.3(3).

**TABLE R303.1.3(1) [Included by WG]  
DEFAULT GLAZED FENESTRATION U-FACTORS**

| FRAME TYPE               | SINGLE PANE | DOUBLE PANE | SKYLIGHT |        |
|--------------------------|-------------|-------------|----------|--------|
|                          |             |             | Single   | Double |
| Metal                    | 1.20        | 0.80        | 2.00     | 1.30   |
| Metal with Thermal Break | 1.10        | 0.65        | 1.90     | 1.10   |
| Nonmetal or Metal Clad   | 0.95        | 0.55        | 1.75     | 1.05   |
| Glazed Block             | 0.60        |             |          |        |

**TABLE R303.1.3(2)**  
**DEFAULT DOOR U-FACTORS [Included by WG]**

| DOOR TYPE  | U-FACTOR |
|--|----------|
| Uninsulated Metal  | 1.20     |
| Insulated Metal  | 0.60     |
| Wood   | 0.50     |
| Insulated, nonmetal edge, max 45% glazing, any glazing double pane | 0.35     |

**R303.1.4 Insulation product rating. [Not Discussed by WG]** The thermal resistance (*R*-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission *R*-value rule (CFR Title 16, Part 460) in units of h·ft<sup>2</sup>·°F/Btu at a mean temperature of 75°F (24°C).

**R303.1.4.1 Insulated siding. [Not Discussed by WG]** The thermal resistance (*R*-value) of insulated siding shall be determined in accordance with ASTM C 1363. Installation for testing shall be in accordance with the manufacturer’s instructions.

**R303.2 Installation. [Not Discussed by WG]** Materials, systems and equipment shall be installed in accordance with the manufacturer’s instructions and the *International Building Code* or *International Residential Code*, as applicable.

**R303.2.1 Protection of exposed foundation insulation. [Not Discussed by WG]** Insulation applied to the exterior of basement walls, crawlspace walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation’s thermal performance. The protective covering shall cover the exposed exterior insulation and extend not less than 6 inches (153 mm) below grade.

**R303.3 Maintenance information. [Not Discussed by WG]** Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

**TABLE R303.1.3(3) [Not Discussed by WG]**  
**DEFAULT GLAZED FENESTRATION SHGC AND VT**

|      | SINGLE GLAZED |        | DOUBLE GLAZED |        | GLAZED BLOCK |
|------|---------------|--------|---------------|--------|--------------|
|      | Clear         | Tinted | Clear         | Tinted |              |
| SHGC | 0.8           | 0.7    | 0.7           | 0.6    | 0.6          |
| VT   | 0.6           | 0.3    | 0.6           | 0.3    | 0.6          |

## CHAPTER 4 [RE] RESIDENTIAL ENERGY EFFICIENCY

### SECTION R401

#### GENERAL

**R401.1 Scope. [Not Discussed by WG]** This chapter applies to residential buildings.

**R401.2 Compliance. [Not Discussed by WG]** Projects shall comply with one of the following:

1. Sections R401 through R404.
2. [Deleted – Term Sheet Supersedes]
3. [Deleted – Term Sheet Supersedes]

**R401.2.1 Tropical zone. [Deleted – Term Sheet Supersedes]**

**R401.3 Certificate (Mandatory). [Revised by WG]** Refer to the HUD code requirements for data plate/compliance certificates.

### SECTION R402

#### BUILDING THERMAL ENVELOPE

**R402.1 General (Prescriptive). [Not Discussed by WG]** The *building thermal envelope* shall meet the requirements of Sections R402.1.1 through R402.1.5.

**Exception:** The following low-energy buildings, or portions thereof, separated from the remainder of the building by *building thermal envelope* assemblies complying with this section shall be exempt from the *building thermal envelope* provisions of Section R402.

1. Those with a peak design rate of energy usage less than 3.4 Btu/h · ft<sup>2</sup> (10.7 W/m<sup>2</sup>) or 1.0 watt/ft<sup>2</sup> of floor area for space-conditioning purposes.
2. Those that do not contain *conditioned space*.

**R402.1.1 Vapor retarder. [Not Discussed by WG]** Wall assemblies in the *building thermal envelope* shall comply with the vapor retarder requirements of Section R702.7 of the *International Residential Code* or Section 1405.3 of the *International Building Code*, as applicable.

**R402.1.2 Insulation and fenestration criteria. [Not Discussed by WG]** The *building thermal envelope* shall meet the requirements of Table R402.1.2, based on the climate zone specified in Chapter 3.

**R402.1.3 R-value computation. [Not Discussed by WG]** Insulation material used in layers, such as framing cavity insulation, or continuous insulation shall be summed to compute the corresponding component *R*-value. The manufacturer's settled *R*-value shall be used for blown insulation. Computed *R*-values shall not include an *R*-value for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table R402.1.2, the manufacturer's labeled *R*-value for insulated siding shall be reduced by R-0.6.

**R402.1.4 U-factor alternative. [Revised by WG]** An assembly with a U-factor equal to or less than that specified in the equivalent U-Factor table shall be permitted as an alternative to the *R*-value in the prescriptive table. The U-factor calculation shall be done using a method consistent with the ASHRAE handbook of fundamentals and shall include the thermal bridging effects of framing materials.

**R402.1.5 Total UA alternative. [Deleted – Term Sheet Supersedes]**

**R402.2 Specific insulation requirements (Prescriptive). [Not Discussed by WG]** In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections R402.2.1 through R402.2.13.

**R402.2.1 Ceilings with attic spaces. [Deleted – Term Sheet Supersedes]**

**TABLE R402.1.2  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup> [Deleted – Term Sheet Supersedes]**

**TABLE R402.1.4  
EQUIVALENT *U*-FACTORS<sup>a</sup> [Deleted – Term Sheet Supersedes]**

- R402.2.2 Ceilings without attic spaces. [Deleted by WG]**
- R402.2.3 Eave baffle. [Included by WG]** For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.
- R402.2.4 Access hatches and doors. [Revised by WG]** Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation. A woodframed or equivalent baffle or retainer is required to be provided when loose-fill insulation is installed, the purpose of which is to prevent the loose-fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed *R*-value of the loose-fill insulation.
- R402.2.5 Mass walls. [Deleted by WG]**
- R402.2.6 Steel-frame ceilings, walls and floors. [Deleted by WG]**
- R402.2.7 Walls with partial structural sheathing. [Deleted by WG]**

**R402.2.8 Floors. [Not Discussed by WG]** Floor framing-cavity insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

**Exception:** The floor framing-cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the bottom side of floor framing where combined with insulation that meets or exceeds the minimum wood frame wall *R*-value in Table 402.1.2 and that extends from the bottom to the top of all perimeter floor framing members.

**R402.2.9 Basement walls. [Not Discussed by WG]** Walls associated with conditioned basements shall be insulated from the top of the *basement wall* down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections R402.1.2 and R402.2.8.

**R402.2.10 Slab-on-grade floors. [Not Discussed by WG]** Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table R402.1.2. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the *exterior wall* and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the *exterior wall*. Slab-edge insulation is not required in jurisdictions designated by the *code official* as having a very heavy termite infestation.

**R402.2.11 Crawl space walls. [Not Discussed by WG]** As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *International Building Code* or *International Residential Code*, as applicable. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

**R402.2.12 Masonry veneer. [Not Discussed by WG]** Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

**R402.2.13 Sunroom insulation. [Not Discussed by WG]** *Sunrooms* enclosing conditioned space shall meet the insulation requirements of this code.

**Exception:** For *sunrooms* with *thermal isolation*, and enclosing conditioned space, the following exceptions to the insulation requirements of this code shall apply:

1. The minimum ceiling insulation *R*-values shall be R-19 in *Climate Zones* 1 through 4 and R-24 in *Climate Zones* 5 through 8.
2. The minimum wall *R*-value shall be R-13 in all *climate zones*. Walls separating a *sunroom* with a *thermal isolation* from *conditioned space* shall meet the *building thermal envelope* requirements of this code.

**R402.3 Fenestration (Prescriptive). [Not Discussed by WG]** In addition to the requirements of Section R402, fenestration shall comply with Sections R402.3.1 through R402.3.6.

**R402.3.1 *U*-factor. [Deleted – Term Sheet Supersedes]**

**R402.3.2 Glazed fenestration SHGC. [Deleted – Term Sheet Supersedes]**

**R402.3.3 Glazed fenestration exemption. [Deleted – Term Sheet Supersedes]**

**R402.3.4 Opaque door exemption. [Not Discussed by WG]** One side-hinged opaque door assembly up to 24 square feet (2.22 m<sup>2</sup>) in area is exempted from the *U*-factor requirement in Section R402.1.4. This exemption shall not apply to the *U*-factor alternative approach in Section R402.1.4 and the total UA alternative in Section R402.1.5.

**R402.3.5 Sunroom fenestration. [Not Discussed by WG]** *Sunrooms* enclosing *conditioned space* shall meet the fenestration requirements of this code.

**Exception:** For *sunrooms* with *thermal isolation* and enclosing *conditioned space* in *Climate Zones* 2 through 8, the maximum fenestration *U*-factor shall be 0.45 and the maximum skylight *U*-factor shall

be 0.70. New fenestration separating the *sunroom* with *thermal isolation* from *conditioned space* shall meet the *building thermal envelope* requirements of this code.

**R402.4 Air leakage (Mandatory).** [Not Discussed by WG] The *building thermal envelope* shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

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

**R402.4.1.1 Installation.** [Revised by WG] The components of the *building thermal envelope* as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction.

**R402.4.1.2 Testing.** [Deleted by WG]

**R402.4.2 Fireplaces.** [Revised by WG] Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

**R402.4.3 Fenestration Air Leakage.** [Deleted by WG]

**R402.4.4 Rooms containing fuel-burning appliances.** [Deferred to DOE by WG] In Climate Zones 3 through 8, where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliances and combustion air opening shall be located outside the building thermal envelope or enclosed in a room, isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than the basement wall *R*-value requirement.

The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through conditioned space to a minimum of R-8.

**Exceptions:**

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.
2. Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the *International Residential Code*.

**R402.4.5 Recessed lighting.** [Not Discussed by WG] Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

**R402.5 Maximum fenestration *U*-factor and SHGC (Mandatory).** [Included in Concept by WG] The area-weighted average maximum fenestration *U*-factor permitted using tradeoffs from Section [Total UA/REScheck option] or [Uo option] shall be 0.40 in HUD Climate Zones 2 through 3. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section [Total UA/REScheck option] or [Uo option] in HUD Climate Zones 1 through 2 shall be 0.40.

**TABLE R402.4.1.1  
AIR BARRIER AND INSULATION INSTALLATION**

| COMPONENT                              | AIR BARRIER CRITERIA  | INSULATION INSTALLATION CRITERIA   |
|--|---|--|
| General requirements                   | A continuous air barrier shall be installed in the building envelope.<br>The exterior thermal envelope contains a continuous air barrier.<br>Breaks or joints in the air barrier shall be sealed. [Included by WG]  | Air-permeable insulation shall not be used as a sealing material. [Included by WG]   |
| Ceiling/attic                          | The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed.<br>Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed. [Included by WG] | The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. [Included by WG]   |
| Walls                                  | The junction of the top plate and the ceiling along exterior walls shall be sealed.<br>The junction of the bottom plate and the floor along exterior walls shall be sealed. [Revised by WG]   | <i>Air permeable exterior thermal envelope insulation for framed walls shall completely fill the cavity, including within stud bays caused by blocking lay flats or headers.</i> [Revised by WG] |
| Windows, skylights and doors           | The space between window/door jambs and framing, and skylights and framing shall be sealed. [Included by WG]  |  |
| Rim joists                             | Rim joists shall include the air barrier. [Included by WG]  | Rim joists shall be insulated. [Included by WG]  |
| Floors [Revised by WG]                 | The air barrier shall be installed at any exposed edge of insulation. The bottom board may serve as the air barrier. [Revised by WG]  | [Deleted by WG]  |
| [Deleted by WG] Crawl space walls      | [Deleted by WG]   | [Deleted by WG]  |
| Shafts, penetrations                   | Duct shafts, utility penetrations, and flue shafts that penetrate the air barrier shall be sealed. [Revised by WG]  |  |
| Narrow cavities                        |   | Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space. [Included by WG]             |
| Garage Separation [Deleted by WG]      | [Deleted by WG]   |  |
| Recessed lighting                      | Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall. [Included by WG]   | Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated. [Included by WG]   |
| Plumbing and Wiring [Deleted by WG]    |   | [Deleted by WG]  |
| Shower/tub on exterior wall            | The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs. [Included by WG]  | Exterior walls adjacent to showers and tubs shall be insulated. [Included by WG]   |
| Electrical/phone box on exterior walls | The air barrier shall be installed behind electrical or communication boxes or the air barrier shall be sealed around the box penetration. [Revised by WG]  |  |
| HVAC register boots                    | HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall. [Included by WG]   |  |
| Concealed sprinklers [Deleted by WG/   | [Deleted by WG]   |  |

## SECTION R403 SYSTEMS

**R403.1 Controls (Mandatory). [Included by WG]** At least one thermostat shall be provided for each separate heating and cooling system.

**R403.1.1 Programmable thermostat. [Included by WG]** The thermostat controlling the primary heating or cooling system of the 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 by the manufacturer 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).

**R403.1.2 Heat pump supplementary heat (Mandatory). [Included by WG]** 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.

**R403.2 Hot water boiler outdoor temperature setback. [Not Discussed by WG]** Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature.

**R403.3 Ducts. [Not Discussed by WG]** Ducts and air handlers shall be in accordance with Sections R403.3.1 through R403.3.5.

**R403.3.1 Insulation (Prescriptive). [Not Discussed by WG]** Supply and return ducts in attics shall be insulated to a minimum of R-8 where 3 inches (76 mm) in diameter and greater and R-6 where less than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to a minimum of R-6 where 3 inches (76 mm) in diameter or greater and R-4.2 where less than 3 inches (76 mm) in diameter.

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

**R403.3.2 Sealing (Mandatory). [Not Discussed by WG]** Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with either the *International Mechanical Code* or *International Residential Code*, as applicable.

**Exceptions:**

1. Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
2. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams, and locking-type joints and seams of other than the snap-lock and button-lock types.

**R403.3.2.1 Sealed air handler. [Not Discussed by WG]** Air handlers shall have a manufacturer's designation for an air leakage of no more than 2 percent of the design air flow rate when tested in accordance with ASHRAE 193.

**R403.3.3 Duct testing (Mandatory). [Deleted – Term Sheet Supersedes]**

**R403.3.4 Duct leakage (Prescriptive). [Deleted – Term Sheet Supersedes]**

**R403.3.5 Building cavities (Mandatory). [Included by WG]** Building framing cavities shall not be used as ducts or plenums.

**R403.4 Mechanical system piping insulation (Mandatory). [Deleted – Term Sheet Supersedes]**

**R403.4.1 Protection of piping insulation. [Not Discussed by WG]** Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

**R403.5 Service hot water systems. [Not Discussed by WG]** Energy conservation measures for service hot water systems shall be in accordance with Sections R403.5.1 and R403.5.4.

**R403.5.1 Heated water circulation and temperature maintenance systems (Mandatory). [Included by WG]** Heated water circulation systems shall be in accordance with Section R403.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Section R403.5.1.2. Automatic controls, temperature sensors and pumps shall be accessible. Manual controls shall be readily accessible.

**R403.5.1.1 Circulation systems. [Included by WG]** Heated water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold

water supply pipe. Gravity and thermosyphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

**R403.5.1.2 Heat trace systems. [Included by WG]** Electric heat trace systems shall comply with IEEE 515.1 or UL 515. Controls for such systems shall automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy.

**R403.5.2 Demand recirculation systems. [Not Discussed by WG]** A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe shall be a *demand recirculation water system*. Pumps shall have controls that comply with both of the following:

1. The control shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance.
2. The control shall limit the temperature of the water entering the cold water piping to 104°F (40°C).

**R403.5.3 Hot water pipe insulation (Prescriptive). [Deleted – Term Sheet Supersedes]**

**R403.5.4 Drain water heat recovery units. [Not Discussed by WG]** Drain water heat recovery units shall comply with CSA B55.2. Drain water heat recovery units shall be tested in accordance with CSA B55.1. Potable water-side pressure loss of drain water heat recovery units shall be less than 3 psi (20.7 kPa) for individual units connected to one or two showers. Potable water-side pressure loss of drain water heat recovery units shall be less than 2 psi (13.8 kPa) for individual units connected to three or more showers.

**R403.6 Mechanical Ventilation (Mandatory) [Revised by WG]** The building shall be provided with ventilation that meets the requirements of the 24 CFR Part 3280 Manufactured Home Construction and Safety Standards. Whole-house mechanical ventilation system fan efficacy shall meet the efficacy requirements of Table R403.6.1.

**Exception:** Where mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.

**R403.6.1 Whole-house mechanical ventilation system fan efficacy. [Deleted by WG]**

**R403.7 Equipment sizing and efficiency rating (Mandatory). [Revised by WG]** Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other DOE approved heating and cooling calculation methodologies.

**R403.8 Systems serving multiple dwelling units (Mandatory). [Deleted by WG]**

**R403.9 Snow melt and ice system controls (Mandatory). [Deleted by WG]**

**TABLE R403.6.1 [Included by WG]  
MECHANICAL VENTILATION SYSTEM FAN EFFICACY**

| FAN LOCATION           | AIR FLOW RATE<br>MINIMUM (CFM) | MINIMUM EFFICACY<br>(CFM/WATT) | AIR FLOW RATE<br>MAXIMUM (CFM) |
|------------------------|--------------------------------|--------------------------------|--------------------------------|
| Range hoods            | Any                            | 2.8                            | Any                            |
| In-line fan            | Any                            | 2.8                            | Any                            |
| bathroom, utility room | 10                             | 1.4                            | <90                            |
| bathroom utility room  | 90                             | 2.8                            | Any                            |

For SI: 1 cfm = 28.3 L/min.

**R403.10 Pools and permanent spa energy consumption (Mandatory). [Deleted by WG]**

**R403.10.1 Residential pools and permanent residential spas. [Deleted by WG]**

**R403.10.2 Heaters. [Deleted by WG]**

**R403.10.3 Time switches. [Deleted by WG]**

**R403.10.4 Covers. [Deleted by WG]**

**R403.11 Portable spas (Mandatory). [Deleted by WG]**

**R403.12 Residential pools and permanent residential spas. [Not Discussed by WG]** Residential swimming pools and permanent residential spas that are accessory to detached one- and two-family dwellings and townhouses three

stories or less in height above grade plane and that are available only to the household and its guests shall be in accordance with APSP-15.

## **SECTION R404 ELECTRICAL POWER AND LIGHTING SYSTEMS**

**R404.1 Lighting equipment (Mandatory).** [Included by WG] Not less than 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 75 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

**Exception:** Low-voltage lighting.

**R404.1.1 Lighting equipment (Mandatory).** [Not Discussed by WG] Fuel gas lighting systems shall not have continuously burning pilot lights.

**SECTION R405 [Deleted – Term Sheet Supersedes]**

**SECTION R406 [Deleted – Term Sheet Supersedes]**

## **CHAPTER 5 (RE) EXISTING BUILDINGS**

[Not Discussed by WG]

### **SECTION R501**

#### **GENERAL**

**R501.1 Scope.** [Not Discussed by WG] The provisions of this chapter shall control the *alteration*, repair, addition and change of occupancy of existing buildings and structures.

**R501.1.1 Additions, alterations, or repairs: General.** [Not Discussed by WG] Additions, alterations, or repairs to an existing building, building system or portion thereof shall comply with Section R502, R503 or R504. Unaltered portions of the existing building or building supply system shall not be required to comply with this code.

**R501.2 Existing buildings.** [Not Discussed by WG] Except as specified in this chapter, this code shall not be used to require the removal, *alteration* or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

**R501.3 Maintenance.** [Not Discussed by WG] Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices and systems that are required by this code shall be maintained in conformance to the code edition under which installed. The owner or the owner's authorized agent shall be responsible for the maintenance of buildings and structures. The requirements of this chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection and safety systems and devices in existing structures.

**R501.4 Compliance.** [Not Discussed by WG] *Alterations, repairs, additions* and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for *alterations, repairs, additions* and changes of occupancy or relocation, respectively, in the *International Residential Code, International Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, International Plumbing Code, International Property Maintenance Code, International Private Sewage Disposal Code* and NFPA 70.

**R501.5 New and replacement materials.** [Not Discussed by WG] Except as otherwise required or permitted by this code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs, provided hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not permit their use in buildings of similar occupancy, purpose and location.

**R501.6 Historic buildings.** [Not Discussed by WG] No provision of this code relating to the construction, *repair, alteration, restoration* and movement of structures, and *change of occupancy* shall be mandatory for *historic buildings* provided a report has been submitted to the code official and signed by the owner, a registered *design professional*, or a representative of the State Historic Preservation Office or the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic form, fabric or function of the *building*.

### **SECTION R502**

## ADDITIONS

**R502.1 General. [Not Discussed by WG]** Additions to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code. Additions shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code where the addition alone complies, where the existing building and addition comply with this code as a single building, or where the building with the addition uses no more energy than the existing building. Additions shall be in accordance with Section R502.1.1 or R502.1.2.

**R502.1.1 Prescriptive compliance. [Not Discussed by WG]** Additions shall comply with Sections R502.1.1.1 through R502.1.1.4.

**R502.1.1.1 Building envelope. [Not Discussed by WG]** New building envelope assemblies that are part of the addition shall comply with Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

**Exception:** Where nonconditioned space is changed to conditioned space, the building envelope of the addition shall comply where the UA, as determined in Section 402.1.4, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to UA generated for the existing building.

**R502.1.1.2 Heating and cooling systems. [Not Discussed by WG]** New heating, cooling and duct systems that are part of the addition shall comply with Sections R403.1, R403.2, R403.3, R403.5 and R403.6.

**Exception:** Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

**R502.1.1.3 Service hot water systems. [Not Discussed by WG]** New service hot water systems that are part of the addition shall comply with Section R403.4.

**R502.1.1.4 Lighting. [Not Discussed by WG]** New lighting systems that are part of the addition shall comply with Section R404.1.

**R502.1.2 Existing plus addition compliance (Simulated Performance Alternative). [Not Discussed by WG]** Where nonconditioned space is changed to conditioned space, the addition shall comply where the annual energy cost or energy use of the addition and the existing building, and any alterations that are part of the project, is less than or equal to the annual energy cost of the existing building when modeled in accordance with Section R405. The addition and any alterations that are part of the project shall comply with Section R405 in its entirety.

## SECTION R503

### ALTERATIONS

**R503.1 General. [Not Discussed by WG]** *Alterations* to any building or structure shall comply with the requirements of the code for new construction. *Alterations* shall be such that the existing building or structure is no less conforming to the provisions of this code than the existing building or structure was prior to the *alteration*. Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems. *Alterations* shall be such that the existing building or structure uses no more energy than the existing building or structure prior to the *alteration*. Alterations to existing buildings shall comply with Sections R503.1.1 through R503.2.

**R503.1.1 Building envelope. [Not Discussed by WG]** Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.12, R402.3.1, R402.3.2, R402.4.3 and R402.4.4.

**Exception:** The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall or floor cavity is not exposed.
4. Roof recover.

5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.
6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided the code does not require the glazing or fenestration assembly to be replaced.

**R503.1.1.1 Replacement fenestration. [Not Discussed by WG]** Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and SHGC as provided in Table R402.1.4.

**R503.1.2 Heating and cooling systems. [Not Discussed by WG]** New heating, cooling and duct systems that are part of the alteration shall comply with Sections R403.1, R403.2, R403.3 and R403.6.

**Exception:** Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

**R503.1.3 Service hot water systems. [Not Discussed by WG]** New service hot water systems that are part of the alteration shall comply with Section R403.4.

**R503.1.4 Lighting. [Not Discussed by WG]** New lighting systems that are part of the alteration shall comply with Section 404.1.

**Exception:** Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

**R503.2 Change in space conditioning. [Not Discussed by WG]** Any nonconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

**Exception:** Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.

## SECTION R504

### REPAIRS

**R504.1 General. [Not Discussed by WG]** Buildings, structures and parts thereof shall be repaired in compliance with Section R501.3 and this section. Work on nondamaged components necessary for the required *repair* of damaged components shall be considered part of the *repair* and shall not be subject to the requirements for *alterations* in this chapter. Routine maintenance required by Section R501.3, ordinary repairs exempt from *permit*, and abatement of wear due to normal service conditions shall not be subject to the requirements for *repairs* in this section.

**R504.2 Application. [Not Discussed by WG]** For the purposes of this code, the following shall be considered repairs:

1. Glass-only replacements in an existing sash and frame.
2. Roof repairs.
3. Repairs where only the bulb and/or ballast within the existing luminaires in a space are replaced provided that the replacement does not increase the installed interior lighting power.

## SECTION R505

### CHANGE OF OCCUPANCY OR USE

**R505.1 General. [Not Discussed by WG]** Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code.

**R505.2 General. [Not Discussed by WG]** Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this code.

**Exception:** Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.

**CHAPTER 6  
REFERENCED STANDARDS**

**[Not Discussed by WG]**

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 106.

|                                      |   |   |   |
|--------------------------------------|---|---|---|
| <b>AAMA</b>                          |   | American Architectural Manufacturers Association<br>1827 Walden Office Square<br>Suite 550<br>Schaumburg, IL 60173-4268 |   |
|                                      |   |   | Referenced in<br>code section<br>number |
| Standard reference number            | Title   |   |   |
| AAMA/WDMA/CSA<br>101/I.S.2/A C440—11 | North American Fenestration Standard/Specifications for<br>Windows, Doors, and Unit Skylights |   | R402.4.3                                |

|                           |   |  |   |
|---------------------------|---|--|---|
| <b>ACCA</b>               |   | Air Conditioning Contractors of America<br>2800 Shirlington Road, Suite 300<br>Arlington, VA 22206 |   |
|                           |   |  | Referenced in<br>code section<br>number |
| Standard reference number | Title                                       |  |   |
| Manual J—2011             | Residential Load Calculation Eighth Edition |  | R403.7                                  |
| Manual S—13               | Residential Equipment Selection             |  | R403.7                                  |

|                           |   |   |   |
|---------------------------|---|---|---|
| <b>APSP</b>               |   | The Association of Pool and Spa Professionals<br>2111 Eisenhower Avenue<br>Alexandria, VA 22314 |   |
|                           |   |   | Referenced in<br>code section<br>number |
| Standard reference number | Title   |   |   |
| APSP 14—11                | American National Standard for Portable Electric Spa Energy<br>Efficiency             |   | R403.10.1,403.11                        |
| APSP 15a—2013             | American National Standard for Residential Swimming Pool<br>and Spa Energy Efficiency |   | R403.12                                 |

|                           |  |   |   |
|---------------------------|--|---|---|
| <b>ASHRAE</b>             |  | American Society of Heating, Refrigerating and Air-<br>Conditioning Engineers, Inc.<br>1791 Tullie Circle, NE<br>Atlanta, GA 30329-2305 |   |
|                           |  |   | Referenced in<br>code section<br>number |
| Standard reference number | Title  |   |   |
| ASHRAE—2013               | ASHRAE Handbook of Fundamentals                                      |   | R402.1.5, Table<br>R405.5.2(1)          |
| ASHRAE 193—2010           | Method of Test for Determining the Airtightness of HVAC<br>Equipment |   | R403.3.2.1                              |

# ASTM

ASTM International  
100 Barr Harbor Drive  
West Conshohocken, PA 19428-2859

| Standard reference number | Title  | Referenced in code section number |
|---------------------------|--|-----------------------------------|
| C 1363—11                 | Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus                                     | R303.1.4.1                        |
| E 283—04                  | Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen | R402.4.4                          |
| E 779—10                  | Standard Test Method for Determining Air Leakage Rate by Fan Pressurization  | R402.4.1.2                        |
| E 1827—11                 | Standard Test Methods for Determining Airtightness of Building Using an Orifice Blower Door  | R402.4.1.2                        |

# CSA

CSA Group  
8501 East Pleasant Valley  
Cleveland, OH 44131-5575

| Standard reference number       | Title   | Referenced in code section number |
|---------------------------------|---|-----------------------------------|
| AAMA/WDMA/CSA 101/I.S.2/A440—11 | North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights  | R402.4.3                          |
| CSA 55.1—2012                   | Test Method for measuring efficiency and pressure loss of drain water heat recovery units | R403.5.4                          |
| CSA 55.2—2012                   | Drain water heat recover units  | R403.5.4                          |

# DASMA

Door and Access Systems Manufacturers Association  
1300 Sumner Avenue  
Cleveland, OH 44115-2851

| Standard reference number | Title  | Referenced in code section number |
|---------------------------|--|-----------------------------------|
| 105—92(R2004)—13          | Test Method for Thermal Transmittance and Air Infiltration of Garage Doors | R303.1.3                          |

# ICC

International Code Council, Inc.  
500 New Jersey Avenue, NW  
6th Floor  
Washington, DC 20001

| Standard reference number | Title   | Referenced in code section number                             |
|---------------------------|---|---|
| IBC—15                    | International Building Code®                              | R201.3, R303.2, R402.1.1, R501.4                              |
| ICC 400—12                | Standard on the Design and Construction of Log Structures | Table R402.5.1.1  |
| IECC—15                   | International Energy Conservation Code®                   | R101.4.1, 403.8   |
| IECC—09                   | 2009 International Energy Conservation Code®              | R406.2  |
| ECC—06                    | 2006 International Energy Conservation Code®              | R202, R406.3.1  |
| IFC—15                    | International Fire Code®                                  | R201.3, R501.4  |
| IFGC—15                   | International Fuel Gas Code®                              | R201.3, R501.4  |
| IMC—15                    | International Mechanical Code®                            | R201.3, R403.3.2, R403.6, R501.4                              |
| IPC—15                    | International Plumbing Code®                              | R201.3, R501.4  |
| IPSDC—15                  | International Private Sewage Disposal Code®               | R501.4  |
| IPMC—15                   | International Property Maintenance Code®                  | R501.4  |
| IRC—15                    | International Residential Code®                           | R201.3, R303.2, R402.1.1, R402.2.11, R403.3.2, R403.6, R501.4 |

# IEEE

The Institute of Electrical and Electronic Engineers, Inc.  
3 Park Avenue  
New York, NY 1016-5997

| Standard reference number | Title   | Referenced in code section number |
|---------------------------|---|-----------------------------------|
| 515.1—2012                | IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications | R403.5.1.2                        |

# NFPA

National Fire Protection Association  
1 Battermarch Park  
Quincy, MA 02169-7471

| Standard reference number | Title                    | Referenced in code section number |
|---------------------------|--------------------------|-----------------------------------|
| 70—14                     | National Electrical Code | R501.4                            |

**NFRC** National Fenestration Rating Council, Inc.  
 6305 Ivy Lane, Suite 140  
 Greenbelt, MD 20770

| Standard reference number | Title  | Referenced in code section number |
|---------------------------|--|-----------------------------------|
| 100—2009                  | Procedure for Determining Fenestration Products <i>U</i> -factors—Second Edition   | R303.1.3                          |
| 200—2009                  | Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence—Second Edition | R303.1.3                          |
| 400—2009                  | Procedure for Determining Fenestration Product Air Leakage—Second Edition  | R402.4.3                          |

**UL** UL LLC  
 333 Pfingsten Road  
 Northbrook, IL 60062

| Standard reference number | Title   | Referenced in code section number |
|---------------------------|---|-----------------------------------|
| 127—11                    | Standard for Factory Built Fireplaces   | R402.4.2                          |
| 515—11                    | Electrical Resistance Heat Tracing for Commercial and Industrial Applications including revisions through November 30, 2011 | R403.5.1.2                        |

**US-FTC** United States-Federal Trade Commission  
 600 Pennsylvania Avenue NW  
 Washington, DC 20580

| Standard reference number   | Title        | Referenced in code section number |
|-----------------------------|--------------|-----------------------------------|
| CFR Title 16 (May 31, 2005) | R-value Rule | R303.1.4                          |

**WDMA** Window and Door Manufacturers Association  
 2025 M street, NW Suite 800  
 Washington, DC 20036-3309

| Standard reference number       | Title  | Referenced in code section number |
|---------------------------------|--|-----------------------------------|
| AAMA/WDMA/CSA 101/I.S.2/A440—11 | North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights | R402.4.3                          |