

---

## CHAPTER 1 [RE]

### SCOPE AND ADMINISTRATION

#### SECTION R101 SCOPE AND GENERAL REQUIREMENTS

**R101.1 Title.** This code shall be known as the *Washington State Energy Code-Residential*, and shall be cited as such. It is referred to herein as "this code."

**R101.2 Scope.** This code applies to *residential buildings* and the buildings sites and associated systems and equipment. This code shall be the maximum and minimum energy code for residential construction in each town, city and county. Residential *sleeping units*, Group I-1, Condition 2 assisted living facilities licensed by Washington state under chapter 388-78A WAC and Group I-1, Condition 2 residential treatment facilities licensed by Washington state under chapter 246-337 WAC shall utilize the commercial building sections of the energy code regardless of the number of stories of height above grade plane.

**R101.3 Intent.** This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

**R101.4 Applicability.** Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

**R101.4.1 Mixed residential and commercial buildings.** Where a building includes both *residential* building and *commercial* building portions, each portion shall be separately considered and meet the applicable provisions of the WSEC - Commercial Provisions or WSEC - Residential Provisions.

**R101.5 Compliance.** *Residential buildings* shall meet the provisions of WSEC - Residential Provisions. *Commercial buildings* shall meet the provisions of WSEC - Commercial Provisions.

**R101.5.1 Compliance materials.** The *code official* shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

#### SECTION R102 ALTERNATIVE MATERIALS, DESIGN AND METHODS OF CONSTRUCTION AND EQUIPMENT

**R102.1 General.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. The code official shall have the authority to approve an alternate material, design or method of construction upon the written application of the owner or the owner's authorized agent. The code official shall first find that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code for strength, effectiveness, fire resistance, durability, energy efficiency and safety. ~~Where the alternative material, design or method of construction is not approved, the~~The code official shall respond in writing, stating the reasons why the alternative was approved or was not approved.

## SECTION R103 CONSTRUCTION DOCUMENTS

**R103.1 General.** Construction documents, technical reports, and other supporting data shall be submitted in one or more sets, or in a digital format where allowed by the code official, with each application for a permit. The construction documents and technical reports shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the *code official* is authorized to require necessary construction documents to be prepared by a registered design professional.

**Exception:** The *code official* is authorized to waive the requirements for construction documents or other supporting data if the *code official* determines they are not necessary to confirm compliance with this code.

**R103.2 Information on construction documents.** Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted when *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Energy compliance path per Section R401.2.
- 1-2. Insulation materials and their R-values.
- 2-3. Fenestration U-factors and SHGCs.
- 3-4. Area-weighted U-factor and SHGC calculations.
- 4-5. Mechanical system design criteria.
- 5-6. Mechanical and service water heating system and equipment types, sizes and efficiencies.
- 6-7. Equipment and systems controls
- 7-8. Duct sealing, duct and pipe insulation and location.
- 8-9. Air sealing details.

**R103.2.1 Building thermal envelope depiction.** The building's thermal envelope shall be represented on the construction documents.

**R103.3 Examination of documents.** The *code official* shall examine or cause to be examined the accompanying construction documents and shall ascertain whether the construction indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances. The *code official* is authorized to utilize a registered design professional or other approved entity not affiliated with the building design or construction in conducting the review of the plans and specifications for compliance with the code.

**R103.3.1 Approval of construction documents.** When the *code official* issues a permit where construction documents are required, the construction documents shall be endorsed in writing and stamped "Reviewed for Code Compliance." Such *approved* construction documents shall not be changed, modified or altered without authorization from the *code official*. Work shall be done in accordance with the *approved* construction documents.

One set of construction documents so reviewed shall be retained by the *code official*. The other set shall be returned to the applicant, kept at the site of work and shall be open to inspection by the *code official* or a duly authorized representative.

**R103.3.2 Previous approvals.** This code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

**R103.3.3 Phased approval.** The *code official* shall have the authority to issue a permit for the construction of part of an energy conservation system before the construction documents for the entire system have been submitted or *approved*, provided adequate information and detailed statements have been filed complying with all pertinent requirements of this code. The holders of such permit shall proceed at their own risk without assurance that the permit for the entire energy conservation system will be granted.

**R103.4 Amended construction documents.** Work shall be installed in accordance with the *approved* construction documents, and any changes made during construction that are not in compliance with the approved construction documents shall be resubmitted for approval as an amended set of construction documents.

**R103.5 Retention of construction documents.** One set of *approved* construction documents shall be retained by the *code official* for a period of not less than 180 days from date of completion of the permitted work, or as required by state or local laws.

## SECTION R107~~R104~~ FEES

~~R107.1~~**R104.1 Fees.** A permit shall not be issued until the fees prescribed in Section R107.2 have been paid, nor shall an amendment to a permit be released until the additional fee, if any, has been paid.

~~R107.2~~**R104.2 Schedule of permit fees.** A fee for each permit shall be paid as required, in accordance with the schedule as established by the applicable governing authority.

~~R107.3~~**R104.3 Work commencing before permit issuance.** Any person who commences any work before obtaining the necessary permits shall be subject to an additional fee established by the *code official*, which shall be in addition to the required permit fees.

~~R107.4~~**R104.4 Related fees.** The payment of the fee for the construction, *alteration*, removal or demolition of work done in connection to or concurrently with the work or activity authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.

~~R107.5~~**R104.5 Refunds.** The *code official* is authorized to establish a refund policy.

## SECTION R104~~R105~~ INSPECTIONS

~~R104.1~~**R105.1 General.** Construction or work for which a permit is required shall be subject to inspection by the *code official* or his or her designated agent, and such construction or work shall remain visible and able to be accessed for inspection purposes until *approved*. It shall be the duty of the permit applicant to cause the work to remain visible and able to be accessed for inspection purposes. Neither the code official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material, product, system or building component required to allow inspection to validate compliance with this code.

~~R104.2~~**R105.2 Required inspections.** The *code official* or his or her designated agent, upon notification, shall make the inspections set forth in Sections ~~R104.2.4~~**R105.2.1** through ~~R104.2.5~~**R105.2.5**.

~~R104.2.1~~**R105.2.1 Footing and foundation inspection.** Inspections associated with footings and foundations shall verify compliance with the code as to R-value, location, thickness, depth of burial and protection of insulation as required by the code and approved plans and specifications.

~~R104.2.2~~**R105.2.2 Framing and rough-in inspection.** Inspections at framing and rough-in shall be made before application of interior finish and shall verify compliance with the code as to types of insulation and corresponding R-values and their correct location and proper installation; fenestration properties (U-factor and SHCG) and proper installation; and air leakage controls as required by the code and approved plans and specifications.

~~R104.2.2.4~~**R105.2.2.1 Wall insulation inspection.** The *code official*, upon notification, shall make a wall insulation inspection in addition to those inspections required in Section R109 of the *International Residential Code*. This inspection shall be made after all wall and cavity insulation is in place and prior to cover.

~~C104.2.3~~**R105.2.3 Plumbing rough-in inspection.** Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding R-values and protection, and required controls.

~~C104.2.4~~**R105.2.4 Mechanical rough-in inspection.** Inspections at mechanical rough-in shall verify compliance as required by the code and approved plans and specifications as to installed HVAC

equipment type and size, required controls, system insulation and corresponding R-value, system air leakage control, programmable thermostats, dampers, whole-house ventilation and minimum fan efficiency.

**Exception:** Systems serving multiple dwelling units shall be inspected in accordance with Section R104.2.5~~C104R105~~.2.4.

**R104.2.5~~R105.2.5~~ Final inspection.** The building shall have a final inspection and not be occupied until *approved*.

**R104.3~~R105.3~~ Reinspection.** A building shall be reinspected when determined necessary by the *code official*.

**R104.4~~R105.4~~ Approved inspection agencies.** The *code official* is authorized to accept reports of third-party inspection agencies not affiliated with the building design or construction, provided such agencies are *approved* as to qualifications and reliability relevant to the building components and systems they are inspecting.

**R104.5~~R105.5~~ Inspection requests.** It shall be the duty of the holder of the permit or their duly authorized agent to notify the *code official* when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this code.

**R104.6~~R105.6~~ Reinspection and testing.** Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made so as to achieve compliance with this code. The work or installation shall then be resubmitted to the *code official* for inspection and testing.

## **SECTION R106** **NOTICE OF APPROVAL**

**R104.7~~R106.1~~ Approval.** After the prescribed tests and inspections indicate that the work complies in all respects with this code, a notice of approval shall be issued by the *code official*.

**R104.7.1~~R106.2~~ Revocation.** The *code official* is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this code wherever the certificate is issued in error, or on the basis of incorrect information supplied, or where it is determined that the building or structure, premise, or portion thereof is in violation of any ordinance or regulation or any of the provisions of this code.

## **SECTION R105~~R107~~** **VALIDITY**

**R105.4~~R107.1~~ General.** If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.

## **SECTION R106~~R108~~** **REFERENCED STANDARDS**

**R106.1~~R108.1~~ Referenced codes and standards.** The codes and standards referenced in this code shall be those listed in Chapter 5, and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections R106.1.1 and R106.1.2.

**R106.1.1~~R108.1.1~~ Conflicts.** Where differences occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

**R106.1.2~~R108.1.2~~ Provisions in referenced codes and standards.** Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

**R106.2~~R108.2~~ Application of references.** References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

**R106.3R108.3 Other laws.** The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law. In addition to the requirements of this code, all occupancies shall conform to the provisions included in the state building code (chapter 19.27 RCW). In case of conflicts among codes enumerated in RCW 19.27.031 (1) through (4) and this code, an earlier named code shall govern over those following. In the case of conflict between the duct sealing and insulation requirements of this code and the duct insulation requirements of Sections 603 and 604 of the *International Mechanical Code*, the duct insulation requirements of this code shall govern.

## **SECTION R107 FEES**

~~**R107.1 Fees.** A permit shall not be issued until the fees prescribed in Section R107.2 have been paid, nor shall an amendment to a permit be released until the additional fee, if any, has been paid.~~

~~**R107.2 Schedule of permit fees.** A fee for each permit shall be paid as required, in accordance with the schedule as established by the applicable governing authority.~~

~~**R107.3 Work commencing before permit issuance.** Any person who commences any work before obtaining the necessary permits shall be subject to an additional fee established by the code official, which shall be in addition to the required permit fees.~~

~~**R107.4 Related fees.** The payment of the fee for the construction, alteration, removal or demolition of work done in connection to or concurrently with the work or activity authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.~~

~~**R107.5 Refunds.** The code official is authorized to establish a refund policy.~~

## **SECTION R108R109 STOP WORK ORDER**

~~**R108.1R109.1 Authority.** Whenever the *code official* finds any work regulated by this code being performed in a manner ~~either~~ contrary to the provisions of this code or in a dangerous or unsafe manner, the *code official* is authorized to issue a stop work order.~~

~~**R108.2R109.2 Issuance.** The stop work order shall be in writing and shall be given to the owner of the property involved, ~~or to~~ the owner's authorized agent, or ~~to~~ the person doing performing the work. Upon issuance of a stop work order, the cited work shall immediately cease. The stop work order shall state the reason for the order, and the conditions under which the cited work ~~will be permitted~~ is authorized to resume.~~

~~**R108.3R109.3 Emergencies.** Where an emergency exists, the *code official* shall not be required to give a written notice prior to stopping the work.~~

~~**R108.4R109.4 Failure to comply.** Any person who shall continue any work after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be subject ~~to a fine as set by the applicable governing~~ fines established by the authority having jurisdiction.~~

## **SECTION R109R110 BOARD MEANS OF APPEALS**

~~**R109.R110.1 General.** In order to hear and decide appeals of orders, decisions or determinations made by the *code official* relative to the application and interpretation of this code, there shall be and is hereby created a board of appeals. ~~The code official shall be an ex officio member of said board but shall have no vote on any matter before the board.~~ The board of appeals shall be appointed by the applicable governing body authority and shall hold office at its pleasure. The board shall adopt rules of procedure for conducting its business, and shall render all decisions and findings in writing to the appellant with a duplicate copy to the *code official*.~~

~~**R109R110.2 Limitations on authority.** An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the~~

provisions of this code do not fully apply or an equally good equivalent or better form of construction is proposed. The board shall have no authority to waive requirements of this code or interpret the administration of this code.

**R409R110.3 Qualifications.** The board of appeals shall consist of members who are qualified by experience and training and are not employees of the jurisdiction.

**R110.4 Administration.** The code official shall take immediate action in accordance with the decision of the board.

## **SECTION ~~R410~~R111** **VIOLATIONS**

It shall be unlawful for any person, firm, or corporation to erect or construct any building, or remodel or rehabilitate any existing building or structure in the state, or allow the same to be done, contrary to or in violation of any of the provisions of this code.

## **SECTION ~~R411~~R112** **LIABILITY**

Nothing contained in this code is intended to be nor shall be construed to create or form the basis for any liability on the part of any city or county or its officers, employees or agents for any injury or damage resulting from the failure of a building to conform to the provisions of this code.



## CHAPTER 2 [RE] DEFINITIONS

### SECTION R201 GENERAL

**R201.1 Scope.** Unless stated otherwise, the following words and terms in this code shall have the meanings indicated in this chapter.

**R201.2 Interchangeability.** 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.** Terms that are not defined in this code but are defined in the *International Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, Uniform Plumbing Code* or the *International Residential Code* shall have the meanings ascribed to them in those codes.

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

### SECTION R202 GENERAL DEFINITIONS

**ABOVE-GRADE WALL.** A wall enclosing *conditioned space* that is not a below-grade wall. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

**ACCESSIBLE (TO).** ~~Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (see "Readily accessible")~~ That which enables a device, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel or similar obstruction.

**ADDITION.** An extension or increase in the *conditioned space* floor area, number of stories, or height of a building or structure.

**ADVANCED FRAMED WALLS.** 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. Headers consist of double 2x material with R-10 insulation between the header and exterior sheathing. Interior partition wall/exterior wall intersections are fully insulated in the exterior wall. (See **Standard Framing** and Appendix A, of this code.)

**AIR BARRIER.** One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the building thermal envelope and its assemblies.

~~**AIR-IMPERMEABLE INSULATION.** An insulation that functions as an air barrier material.~~

**ALTERATION.** Any construction, retrofit or renovation to an existing structure other than repair or addition. Also, a change in a building, electrical, gas, mechanical or plumbing system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

**APPROVED.** Acceptable to the *code official*.

**APPROVED AGENCY.** An established and recognized agency that is regularly engaged in conducting tests or furnishing inspection services, or furnishing product certification, where such agency has been approved by the code official.

**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.** See *above-grade wall* and *below-grade wall*.

**BELOW-GRADE WALL.** That portion of a wall in the building envelope that is entirely below the finish grade and in contact with the ground.

**BUILDING.** Any structure used or intended for supporting or sheltering any use or occupancy, including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building.

**BUILDING SITE.** A contiguous area of land that is under the ownership or control of one entity.

**BUILDING THERMAL ENVELOPE.** The below-grade walls, above-grade walls, floors, ceiling, roofs, and any other building element assemblies that enclose conditioned space or provide a boundary between *conditioned space* and exempt or unconditioned space.

**C-FACTOR (THERMAL CONDUCTANCE).** 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)].

**CAVITY INSULATION.** Insulating material located between framing members.

**CIRCULATING HOT WATER SYSTEM.** 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 the fixture supply and back to the water-heating equipment.

**CLIMATE ZONE.** A geographical region based on climatic criteria as specified in this code.

**CODE OFFICIAL.** The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

**COMMERCIAL BUILDING.** For this code, all buildings that are not included in the definition of "Residential buildings."

**CONDITIONED FLOOR AREA.** The horizontal projection of the floors associated with the *conditioned space*.

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

**CONNECTED THERMOSTAT.** An internet enabled device that automatically adjusts heating and cooling temperature settings.

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

**CONTINUOUS INSULATION (c.i.).** 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.

**CURTAIN WALL.** Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

**DEMAND RECIRCULATION WATER SYSTEM.** A water distribution system having where 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 pumps prime the service hot water piping with heated water upon demand for hot water.

**DIMMER.** A control device that is capable of continuously varying the light output and energy use of light sources.

**DUCT.** 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.** 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.

**DUCTLESS MINI-SPLIT HEAT PUMP SYSTEM.** A heating and cooling system that is comprised of one or multiple indoor evaporator/air-handling units and an outdoor condensing unit that is connected by refrigerant piping and electrical wiring. A ductless mini-split system is capable of cooling or heating one or more rooms without the use of a central ductwork system.

**DWELLING UNIT.** A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

**DWELLING UNIT ENCLOSURE AREA.** The sum of the area of ceiling, floors and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.

**ENERGY ANALYSIS.** A method for estimating the annual energy use of the *proposed design* and *standard reference design* based on estimates of energy use.

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

**ENERGY SIMULATION TOOL.** An *approved* software program or calculation-based methodology that projects the annual energy use of a building.

**EXTERIOR WALL.** Walls including both above-grade walls and below-grade walls.

**FENESTRATION.** Products classified as either vertical fenestration or skylights.

**VERTICAL FENESTRATION.** Windows (fixed or operable), 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 not less than 60 degrees from horizontal. Opaque areas such as spandrel panels are not considered vertical fenestration.

**SKYLIGHT.** Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees from horizontal, including unit skylights, tubular daylighting devices and glazing materials in solariums, sunrooms, roofs and sloped walls.

**FENESTRATION AREA.** Total area of the fenestration measured using the rough opening, and including the glazing, sash and frame.

**FENESTRATION PRODUCT, FIELD-FABRICATED.** A fenestration product whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-built fenestration.

**FENESTRATION PRODUCT, SITE-BUILT.** A fenestration designed to be made up of field-glazed or field-assembled units using specific factory cut or otherwise factory-formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems.

**F-FACTOR.** The perimeter heat loss factor for slab-on-grade floors (Btu/h × ft × °F) [W/(m × K)].

**HEATED SLAB-ON-GRADE FLOOR.** Slab-on-grade floor construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

**HIGH-EFFICACY LIGHT SOURCES.** Fixtures that use light emitting diodes (LED), T-8 or smaller diameter linear fluorescent lamps, or other lamps with a minimum efficacy of 65 lumens per watt. Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or small diameter linear fluorescent lamps, or other lamps with an efficacy of not less than 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.

**HISTORIC BUILDINGS.** Buildings that are listed in or eligible for listing in the *National Register of Historic Places*, or designated as historic under an appropriate state or local law.

**INFILTRATION.** 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.

**INSULATING SHEATHING.** An insulating board with a core material having a minimum *R*-value of R-2.

**INSULATING SIDING.** 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.

**INTEGRATED ENERGY EFFICIENCY RATIO (IEER).** A single-number figure of merit expressing cooling part-load EER efficiency for unitary air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

**INTERMEDIATE FRAMED WALLS.** 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. Headers shall be insulated to R-10.

**LABELED.** Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, *approved* agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

**LISTED.** Equipment, materials, products or services included in a list published by an organization acceptable to the *code official* and concerned with evaluation of products or services that maintains periodic inspection of production of *listed* equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

**LOG STRUCTURE.** A type of construction whose primary structural elements are formed by a system of logs.

**LOG WALL.** An assembly of individual structural logs for use as an exterior or interior load bearing wall, shear wall or nonload bearing wall.

**LOW-VOLTAGE LIGHTING.** A lighting system consisting of an isolating power supply, the low voltage luminaires, and associated equipment that are all identified for the use. The output circuits of the power supply operate at 30 volts (42.4 volts peak) or less under all load conditions.

**MANUAL.** Capable of being operated by personal intervention (see "Automatic").

**OCCUPANT SENSOR CONTROL.** An automatic control device that detects the presence or absence of people within an area and causes lighting, equipment or appliances to be regulated accordingly.

**ON-SITE RENEWABLE ENERGY.** Energy from renewable energy resources harvested at the building site.

**OPAQUE DOOR.** A door that is not less than 50 percent opaque in surface area.

**PILOT LIGHT, CONTINUOUSLY BURNING.** A small gas flame used to ignite gas at a larger burning. Once lit, a continuously burning pilot light remains in operation until manually interrupted. Pilot light ignition systems with the ability to switch between intermittent and continuous mode are considered continuous.

**PILOT LIGHT, INTERMITTENT.** A pilot which is automatically ignited when an appliance is called on to operate and which remains continuously ignited during each period of main burner operation. The pilot is automatically extinguished when each main burner operating cycle is completed.

**PILOT LIGHT, INTERRUPTED.** A pilot which is automatically ignited prior to the admission of fuel to the main burner and which is automatically extinguished after the main flame is established.

**PILOT LIGHT, ON-DEMAND.** A pilot which, once placed into operation, is intended to remain ignited for a predetermined period of time following an automatic or manual operation of the main burner gas valve

**PROPOSED DESIGN.** A description of the proposed building used to estimate annual energy use for determining compliance based on total building performance.

**READILY ACCESSIBLE (TO).** Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "Accessible") That which enables a device, appliance or equipment to be directly reached without requiring the removal or movement of any panel or similar obstruction.

**RENEWABLE ENERGY CERTIFICATE (REC).** An instrument that represents the environmental attributes of one megawatt hour of renewable energy; also known as an energy attribute certificate (EAC).

**RENEWABLE ENERGY RESOURCES.** Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or extracted from hot fluid or steam heated within the earth.

**REPAIR.** The reconstruction or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.

**REROOFING.** The process of recovering or replacing an existing roof covering. See “Roof recover” and “Roof replacement.”

**RESIDENTIAL BUILDING.** For this code, includes detached one- and two-family dwellings, multiple single-family dwellings (townhouses) and Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane, as well as accessory structures thereto.

**ROOF ASSEMBLY.** A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof covering, underlayment and roof deck, and can also include a thermal barrier, an ignition barrier, insulation or a vapor retarder.

**ROOF RECOVER.** The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

**ROOF REPAIR.** Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

**ROOF REPLACEMENT.** The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

**R-VALUE (THERMAL RESISTANCE).** 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.** Supply of hot water for purposes other than comfort heating.

**SLAB-ON-GRADE FLOOR.** That portion of a slab floor of the building envelope that is in contact with the ground and that is either above grade or is less than or equal to 24 inches below the final elevation of the nearest exterior grade.

**SMALL BUSINESS.** Any business entity (including a sole proprietorship, corporation, partnership or other legal entity) which is owned and operated independently from all other businesses, which has the purpose of making a profit, and which has fifty or fewer employees.

**SOLAR HEAT GAIN COEFFICIENT (SHGC).** 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 which is then reradiated, conducted or convected into the space.

**STANDARD FRAMING.** All framing practices not defined as "intermediate" or "advanced" shall be considered standard. (See **Advanced Framed Wall, Intermediate Framed Wall**).

**STANDARD REFERENCE DESIGN.** A version of the *proposed design* that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

**THERMAL DISTRIBUTION EFFICIENCY (TDE).** The resistance to changes in air heat as air is conveyed through a distance of air duct. TDE is a heat loss calculation evaluating the difference in the heat of the air between the air duct inlet and outlet caused by differences in temperatures between the air in the duct and the duct material. TDE is expressed as a percent difference between the inlet and outlet heat in the duct.

**THERMAL ISOLATION.** 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.** An automatic control device used to maintain temperature at a fixed or adjustable set point.

**U-FACTOR (THERMAL TRANSMITTANCE).** 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 (Btu/h • ft<sup>2</sup> • °F) [W/(m<sup>2</sup> • K)].

**UNHEATED SLAB-ON-GRADE FLOOR.** A slab-on-grade floor that is not a heated slab-on-grade floor.

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

**VENTILATION AIR.** 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.

**VISIBLE TRANSMITTANCE [VT].** The ratio of visible light entering the space through the fenestration product assembly to the incident visible light, visible transmittance, includes the effects of glazing material and frame and is expressed as a number between 0 and 1.

**WHOLE HOUSE MECHANICAL VENTILATION SYSTEM.** 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.

**ZONE.** 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

**R301.1 General.** Climate zones from Table R301.1 shall be used in determining the applicable requirements from Chapter 4.

**TABLE R301.1  
CLIMATE ZONES, MOISTURE REGIMES,  
AND WARM-HUMID DESIGNATIONS  
BY STATE AND COUNTY**

|                                                                                                                     |                 |
|---------------------------------------------------------------------------------------------------------------------|-----------------|
| Key: A - Moist, B - Dry, C - Marine.<br>Absence of moisture designation indicates<br>moisture regime is irrelevant. |                 |
| <b>WASHINGTON</b>                                                                                                   |                 |
| 5B Adams                                                                                                            | 4C Lewis        |
| 5B Asotin                                                                                                           | 5B Lincoln      |
| 5B Benton                                                                                                           | 4C Mason        |
| 5B Chelan                                                                                                           | 5B Okanogan     |
| 4C Clallam                                                                                                          | 4C Pacific      |
| 4C Clark                                                                                                            | 5B Pend Oreille |
| 5B Columbia                                                                                                         | 4C Pierce       |
| 4C Cowlitz                                                                                                          | 4C San Juan     |
| 5B Douglas                                                                                                          | 4C Skagit       |
| 5B Ferry                                                                                                            | 5B Skamania     |
| 5B Franklin                                                                                                         | 4C Snohomish    |
| 5B Garfield                                                                                                         | 5B Spokane      |
| 5B Grant                                                                                                            | 5B Stevens      |
| 4C Grays Harbor                                                                                                     | 4C Thurston     |
| 4C Island                                                                                                           | 4C Wahkiakum    |
| 4C Jefferson                                                                                                        | 5B Walla Walla  |
| 4C King                                                                                                             | 4C Whatcom      |
| 4C Kitsap                                                                                                           | 5B Whitman      |
| 5B Kittitas                                                                                                         | 5B Yakima       |
| 5B Klickitat                                                                                                        |                 |

## SECTION R302 DESIGN CONDITIONS

**R302.1 Interior design conditions.** 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.

**R302.2 Exterior design conditions.** The heating or cooling outdoor design temperatures shall be selected from Appendix C.

## SECTION R303 MATERIALS, SYSTEMS AND EQUIPMENT

**R303.1 Identification.** 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.** 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.

**Exception:** For roof insulation installed above the deck, the *R*-value shall be labeled as required by the material standards specified in Table 1508.2 of the *International Building Code* or Table R906.2 of the *International Residential Code*.

**R303.1.1.1 Blown or sprayed roof/ceiling insulation.** 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 a minimum of 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.** Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection. For insulation materials that are installed without an observable manufacturer's *R*-value mark, such as blown or draped products, an insulation certificate complying with Section R303.1.1 shall be left immediately after installation by the installer, in a conspicuous location within the building, to certify the installed *R*-value of the insulation material.

**R303.1.3 Fenestration product rating.** *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), R303.1.3(2) or R303.1.3(4). 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).

**Exceptions:**

1. Units without NFRC ratings produced by a *small business* may be assigned default *U*-factors from Table R303.1.3(5) for vertical fenestration.



2. Owner-built, nonoperable wood frame window consisting of a double pane unit with low-e (E=0.04 or less), ½-inch airspace with argon fill.

**TABLE R303.1.3(1)  
DEFAULT GLAZED WINDOW, GLASS DOOR AND SKYLIGHT U-FACTOR**

| FRAME TYPE                            | WINDOW AND GLASS DOOR |             | SKYLIGHT                     |
|---------------------------------------|-----------------------|-------------|------------------------------|
|                                       | SINGLE PANE           | DOUBLE PANE |                              |
| Metal                                 | 1.20                  | 0.80        | <b>See Table R303.1.3(4)</b> |
| Metal with Thermal Break <sup>a</sup> | 1.10                  | 0.65        |                              |
| Nonmetal or Metal Clad                | 0.95                  | 0.55        |                              |
| Glazed Block                          | 0.60                  |             |                              |

- a. Metal Thermal Break = A metal thermal break framed window shall incorporate the following minimum design characteristics:
  - 1) The thermal conductivity of the thermal break material shall be not more than 3.6 Btu-in/h/ft<sup>2</sup>/°F;
  - 2) The thermal break material must produce a gap in the frame material of not less than 0.210 inches; and
  - 3) All metal framing members of the products exposed to interior and exterior air shall incorporate a thermal break meeting the criteria in 1) and 2) above.

**R303.1.4 Insulation product rating.** The thermal resistance (*R*-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission *R*-value rule (C.F.R. 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.** The thermal resistance (*R*-value) of insulated siding shall be determined in accordance with ASTM C1363. Installation for testing shall be in accordance with the manufacturer's installation instructions.

**R303.1.5 Air-impermeable insulation.** Insulation having an air permeability not greater than 0.004 cubic feet per minute per square foot [0.002 L/(s × m<sup>2</sup>)] under pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall be determined air-impermeable insulation.

**R303.2 Installation.** All materials, systems and equipment shall be installed in accordance with the manufacturer's installation instructions and the *International Building Code* or *International Residential Code*, as applicable.

**R303.2.1 Protection of exposed foundation insulation.** 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 a minimum of 6 inches (153 mm) below grade.

**R303.3 Maintenance information.** 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-visible 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(2)  
DEFAULT OPAQUE DOOR U-FACTORS**

| Door Type                                                             | No Glazed Fenestration | Single Glazing | Double Glazing with ¼ in. Airspace | Double Glazing with ½ in. Airspace | Double Glazing with e=0.10, ½ in. Argon |
|-----------------------------------------------------------------------|------------------------|----------------|------------------------------------|------------------------------------|-----------------------------------------|
| <b>SWINGING DOORS (Rough opening – 38 in. x 82 in.)</b>               |                        |                |                                    |                                    |                                         |
| <b>Slab Doors</b>                                                     |                        |                |                                    |                                    |                                         |
| Wood slab in wood frame <sup>a</sup>                                  | 0.46                   |                |                                    |                                    |                                         |
| 6% glazed fenestration (22 in. x 8 in. lite)                          | –                      | 0.48           | 0.47                               | 0.46                               | 0.44                                    |
| 25% glazed fenestration (22 in.x36 in. lite)                          | –                      | 0.58           | 0.48                               | 0.46                               | 0.42                                    |
| 45% glazed fenestration (22 in.x64 in. lite)                          | –                      | 0.69           | 0.49                               | 0.46                               | 0.39                                    |
| More than 50% glazed fenestration                                     | Use Table R303.1.3(1)  |                |                                    |                                    |                                         |
| Insulated steel slab with wood edge in wood frame <sup>a</sup>        | 0.16                   |                |                                    |                                    |                                         |
| 6% glazed fenestration (22 in. x 8 in. lite)                          | –                      | 0.21           | 0.20                               | 0.19                               | 0.18                                    |
| 25% glazed fenestration (22 in.x36 in. lite)                          | –                      | 0.39           | 0.28                               | 0.26                               | 0.23                                    |
| 45% glazed fenestration (22 in.x64 in. lite)                          | –                      | 0.58           | 0.38                               | 0.35                               | 0.26                                    |
| More than 50% g glazed fenestration                                   | Use Table R303.1.3(1)  |                |                                    |                                    |                                         |
| Foam insulated steel slab with metal edge in steel frame <sup>b</sup> | 0.37                   |                |                                    |                                    |                                         |
| 6% glazed fenestration (22 in. x 8 in. lite)                          | –                      | 0.44           | 0.42                               | 0.41                               | 0.39                                    |
| 25% glazed fenestration (22 in.x36 in. lite)                          | –                      | 0.55           | 0.50                               | 0.48                               | 0.44                                    |
| 45% glazed fenestration (22 in.x64 in. lite)                          | –                      | 0.71           | 0.59                               | 0.56                               | 0.48                                    |
| More than 50% glazed fenestration                                     | Use Table R303.1.3(1)  |                |                                    |                                    |                                         |
| Cardboard honeycomb slab with metal edge in steel frame <sup>b</sup>  | 0.61                   |                |                                    |                                    |                                         |
| <b>Style and Rail Doors</b>                                           |                        |                |                                    |                                    |                                         |
| Sliding glass doors/French doors                                      | Use Table R303.1.3(1)  |                |                                    |                                    |                                         |
| <b>Site-Assembled Style and Rail Doors</b>                            |                        |                |                                    |                                    |                                         |
| Aluminum in aluminum frame                                            | –                      | 1.32           | 0.99                               | 0.93                               | 0.79                                    |
| Aluminum in aluminum frame with thermal break                         | –                      | 1.13           | 0.80                               | 0.74                               | 0.63                                    |

Note: Appendix A Tables A107.1(2) through A107.1(4) may also be used if applicable.

a Thermally broken sill (add 0.03 for nonthermally broken sill).

b Nonthermally broken sill.

**TABLE R303.1.3(3)  
DEFAULT GLAZED FENESTRATION SHGC AND VT**

|             | SINGLE GLAZED |        | DOUBLE GLAZED |        | GLAZED BLOCK |
|-------------|---------------|--------|---------------|--------|--------------|
|             | Clear         | Tinted | Clear         | Tinted |              |
| <b>SHGC</b> | 0.8           | 0.7    | 0.7           | 0.6    | 0.6          |
| <b>VT</b>   | 0.6           | 0.3    | 0.6           | 0.3    | 0.6          |

**TABLE R303.1.3(4)  
DEFAULT U-FACTORS FOR SKYLIGHTS**

| Fenestration Type                       | Frame Type                     |                             |                                               |                                                    |
|-----------------------------------------|--------------------------------|-----------------------------|-----------------------------------------------|----------------------------------------------------|
|                                         | Aluminum Without Thermal Break | Aluminum With Thermal Break | Reinforced Vinyl/ Aluminum-Clad Wood or Vinyl | Wood or Vinyl-Clad Wood/ Vinyl without Reinforcing |
| Single Glazing                          |                                |                             |                                               |                                                    |
| glass                                   | U-1.58                         | U-1.51                      | U-1.40                                        | U-1.18                                             |
| acrylic/polycarb                        | U-1.52                         | U-1.45                      | U-1.34                                        | U-1.11                                             |
| Double Glazing                          |                                |                             |                                               |                                                    |
| air                                     | U-1.05                         | U-0.89                      | U-0.84                                        | U-0.67                                             |
| argon                                   | U-1.02                         | U-0.86                      | U-0.80                                        | U-0.64                                             |
| Double Glazing, e=0.20                  |                                |                             |                                               |                                                    |
| air                                     | U-0.96                         | U-0.80                      | U-0.75                                        | U-0.59                                             |
| argon                                   | U-0.91                         | U-0.75                      | U-0.70                                        | U-0.54                                             |
| Double Glazing, e=0.10                  |                                |                             |                                               |                                                    |
| air                                     | U-0.94                         | U-0.79                      | U-0.74                                        | U-0.58                                             |
| argon                                   | U-0.89                         | U-0.73                      | U-0.68                                        | U-0.52                                             |
| Double Glazing, e=0.05                  |                                |                             |                                               |                                                    |
| air                                     | U-0.93                         | U-0.78                      | U-0.73                                        | U-0.56                                             |
| argon                                   | U-0.87                         | U-0.71                      | U-0.66                                        | U-0.50                                             |
| Triple Glazing                          |                                |                             |                                               |                                                    |
| air                                     | U-0.90                         | U-0.70                      | U-0.67                                        | U-0.51                                             |
| argon                                   | U-0.87                         | U-0.69                      | U-0.64                                        | U-0.48                                             |
| Triple Glazing, e=0.20                  |                                |                             |                                               |                                                    |
| air                                     | U-0.86                         | U-0.68                      | U-0.63                                        | U-0.47                                             |
| argon                                   | U-0.82                         | U-0.63                      | U-0.59                                        | U-0.43                                             |
| Triple Glazing, e=0.20 on 2 surfaces    |                                |                             |                                               |                                                    |
| air                                     | U-0.82                         | U-0.64                      | U-0.60                                        | U-0.44                                             |
| argon                                   | U-0.79                         | U-0.60                      | U-0.56                                        | U-0.40                                             |
| Triple Glazing, e=0.10 on 2 surfaces    |                                |                             |                                               |                                                    |
| air                                     | U-0.81                         | U-0.62                      | U-0.58                                        | U-0.42                                             |
| argon                                   | U-0.77                         | U-0.58                      | U-0.54                                        | U-0.38                                             |
| Quadruple Glazing, e=0.10 on 2 surfaces |                                |                             |                                               |                                                    |
| air                                     | U-0.78                         | U-0.59                      | U-0.55                                        | U-0.39                                             |
| argon                                   | U-0.74                         | U-0.56                      | U-0.52                                        | U-0.36                                             |
| krypton                                 | U-0.70                         | U-0.52                      | U-0.48                                        | U-0.32                                             |

Notes for Table R303.1.3(4)

1. U-factors are applicable to glass and plastic, flat and domed units, all spacers and gaps.
2. Emissivities shall be less than or equal to the value specified.
3. Gap fill shall be assumed to be air unless there is a minimum of 90% argon or krypton.
4. Aluminum frame with thermal break is as defined in footnote 1 to Table R303.1.3(1).

**TABLE R303.1.3(5)**  
**SMALL BUSINESS COMPLIANCE TABLE**  
**DEFAULT U-FACTORS FOR VERTICAL FENESTRATION**

| Vertical Fenestration Description |                    |                  |       | Frame Type |                                     |                               |
|-----------------------------------|--------------------|------------------|-------|------------|-------------------------------------|-------------------------------|
|                                   |                    |                  |       | Any Frame  | Aluminum Thermal Break <sup>b</sup> | Wood/Vinyl/Fiberglass         |
| Panes                             | Low-e <sup>a</sup> | Spacer           | Fill  |            |                                     |                               |
| Double <sup>c</sup>               | A                  | Any              | Argon | 0.48       | 0.41                                | 0.32                          |
|                                   | B                  | Any              | Argon | 0.46       | 0.39                                | 0.30                          |
|                                   | C                  | Any              | Argon | 0.44       | 0.37                                | 0.28                          |
|                                   | C                  | High Performance | Argon | 0.42       | 0.35                                | Deemed to comply <sup>e</sup> |
| Triple <sup>d</sup>               | A                  | Any              | Air   | 0.50       | 0.44                                | 0.26                          |
|                                   | B                  | Any              | Air   | 0.45       | 0.39                                | 0.22                          |
|                                   | C                  | Any              | Air   | 0.41       | 0.34                                | 0.20                          |
|                                   | Any double low-e   | Any              | Air   | 0.35       | 0.32                                | 0.18                          |

- a. Low-eA (emissivity) shall be 0.24 to 0.16.  
 Low-eB (emissivity) shall be 0.15 to 0.08.  
 Low-eC (emissivity) shall be 0.07 or less.
- b. Aluminum Thermal Break = An aluminum thermal break framed window shall incorporate the following minimum design characteristics:
  - 1) The thermal conductivity of the thermal break material shall be not more than 3.6 Btu-in/h/ft<sup>2</sup>/°F;
  - 2) The thermal break material must produce a gap in the frame material of not less than 0.210 inches; and
  - 3) All metal framing members of the products exposed to interior and exterior air shall incorporate a thermal break meeting the criteria in 1) and 2) above.
- c. A minimum air space of 0.375 inches between panes of glass is required for double glazing.
- d. A minimum air space of 0.25 inches between panes of glass is required for triple glazing.
- e. Deemed to comply glazing shall not be used for performance compliance.

## CHAPTER 4 [RE]

### RESIDENTIAL ENERGY EFFICIENCY

#### SECTION R401 GENERAL

**R401.1 Scope.** This chapter applies to *residential buildings*.

**R401.2 Compliance.** Projects shall comply with one of the following:

1. Sections R401 through R404. In addition, *dwelling units* and *sleeping units* in a *residential building* shall comply with Section R406.
2. Section R405. In addition, *dwelling units* and *sleeping units* in a *residential building* shall comply with Section R406.
3. Section R407.

**R401.3 Certificate.** A permanent certificate shall be completed by the builder or other *approved* party and posted on a wall in the space where the furnace is located, a utility room, or an *approved* location inside the *building*. When located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. The certificate shall indicate the following:

- ~~1. List~~ The predominant *R*-values of insulation installed in or on ceiling/roof, walls, foundation (slab, below-grade wall, and/or floor) and ducts outside conditioned spaces.;
- ~~2. U-factors for fenestration and the solar heat gain coefficient (SHGC) of fenestration.;~~ Where there is more than one value for each component, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
- ~~3. The results from any required duct system and building envelope air leakage testing done on the building.;~~
- ~~and 4. The results from the whole-house mechanical ventilation system flow rate test. Where there is more than one value for each component, the certificate shall list the value covering the largest area.~~
- ~~5. The certificate shall list the types, sizes and efficiencies of heating, cooling, whole-house mechanical ventilation, and service water heating appliances. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall list "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be listed for gas-fired unvented room heaters, electric furnaces or electric baseboard heaters.~~
- ~~6. Where on-site photovoltaic panel systems have been installed, the array capacity, inverter efficiency, panel tilt, and orientation and estimated annual electrical generation shall be noted on the certificate.~~
- ~~7. The code edition under which the structure was permitted, and the compliance path used.~~

The code official may require that documentation for any required test results include an electronic record of the time, date and location of the test. A date-stamped smart phone photo or air leakage testing software may be used to satisfy this requirement.

## SECTION R402 BUILDING THERMAL ENVELOPE

**R402.1 General (Prescriptive).** The *building thermal envelope* shall meet the requirements of Sections R402.1.1 through R402.1.6.

**Exception:** The following buildings, or portions thereof, separated from the remainder of the building by building thermal envelope assemblies complying with this code shall be exempt from the building thermal envelope provisions of this code:

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.
3. Greenhouses isolated from any conditioned space and not intended for occupancy.

**~~R402.1.1~~ ~~R402.1.6~~ Vapor retarder.** 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.

**~~R402.1.4-2~~ Insulation and fenestration criteria.** The *building thermal envelope* shall meet the requirements of Table R402.1.4~~2~~ based on the climate zone specified in Chapter 3. Assemblies shall have a U-factor equal to or less than that specified in Table R402.1.2. Fenestration shall have a U-factor equal to or less than specified in Table R402.1.2.

**TABLE R402.1.4~~2~~**  
**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

| <del>CLIMATE ZONE 5 AND MARINE 4</del>       |                 |
|----------------------------------------------|-----------------|
| <del>Fenestration U-Factor<sup>b</sup></del> | <del>0.30</del> |
| <del>Skylight<sup>b</sup> U-Factor</del>     | <del>0.50</del> |
| <del>Ceiling R-Value<sup>e</sup></del>       | <del>40</del>   |

|                                               |                           |
|-----------------------------------------------|---------------------------|
| <b>Wood Frame Wall<sup>g,h</sup> R-Value</b>  | <b>21 int</b>             |
| <b>Floor R-Value</b>                          | <b>30</b>                 |
| <b>Below-Grade<sup>e,h</sup> Wall R-value</b> | <b>10/15/21 int + 5TB</b> |
| <b>Slab<sup>d,f</sup> R-Value &amp; Depth</b> | <b>10, 2 ft</b>           |

| <b>CLIMATE ZONE 5 AND MARINE 4</b>       |              |
|------------------------------------------|--------------|
| <b>Fenestration U-Factor<sup>d</sup></b> | <b>0.30</b>  |
| <b>Skylight U-Factor</b>                 | <b>0.50</b>  |
| <b>Ceiling U-Factor</b>                  | <b>0.024</b> |
| <b>Above-Grade Wall U-Factor</b>         | <b>0.056</b> |
| <b>Floor U-Factor</b>                    | <b>0.029</b> |
| <b>Slab on Grade F-Factor</b>            | <b>0.54</b>  |
| <b>Below Grade 2' Depth</b>              |              |
| Wall U-Factor                            | 0.042        |
| Slab F-Factor                            | 0.59         |
| <b>Below Grade 3.5' Depth</b>            |              |
| Wall U-Factor                            | 0.040        |
| Slab F-Factor                            | 0.56         |
| <b>Below Grade 7' Depth</b>              |              |
| Wall U-Factor                            | 0.035        |
| Slab F-Factor                            | 0.50         |

For SI: 1 foot = 304.8 mm, ci = continuous insulation, int = intermediate framing.

- a. U-factors or F-factors shall be obtained from measurement, calculation or an approved source, or as specified in Section R402.1.5.
- b. A maximum U-factor of 0.32 shall apply to vertical fenestration products installed in buildings located above 4000 feet in elevation above sea level, or in windborne debris regions where protection of openings is required under Section R301.2.1.2 of the International Residential Code.
- ~~a. R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the compressed R-value of the insulation from Appendix Table A101.4 shall not be less than the R-value specified in the table.~~
- ~~b.a. The fenestration U-factor column excludes skylights.~~
- ~~c.a. "10/15/21 +5TB" means R-10 continuous insulation on the exterior of the wall, or R-15 continuous insulation on the interior of the wall, or R-21 cavity insulation plus a thermal break between the slab and the basement wall at the interior of the basement wall. "10/15/21 +5TB" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the wall. "5TB" means R-5 thermal break between floor slab and basement wall.~~
- ~~d.a. R-10 continuous insulation is required under heated slab on grade floors. See Section R402.2.9.1.~~
- ~~e.a. For single rafter or joist vaulted ceilings, the insulation may be reduced to R-38 if the full insulation depth extends over the top plate of the exterior wall.~~
- ~~f.a. R-7.5 continuous insulation installed over an existing slab is deemed to be equivalent to the required perimeter slab insulation when applied to existing slabs complying with Section R503.1.1. If foam plastic is used, it shall meet the requirements for thermal barriers protecting foam plastics.~~
- ~~g.a. For log structures developed in compliance with Standard ICC-400, log walls shall meet the requirements for climate zone 5 of ICC-400.~~
- ~~h.a. Int. (intermediate framing) denotes framing and insulation as described in Section A103.2.2 including standard framing 16 inches on center, 78 percent of the wall cavity insulated and headers insulated with a minimum of R-10 insulation.~~



~~**R402.1.3 U-factor R-value alternative.** An assembly with a *U* factor equal to or less than that specified in Table R402.1.3 shall be permitted as an alternative to the *R*-value in Table R402.1.1. *U*-factors shall be determined as specified in Section R402.1.5.~~ ~~Assemblies with *R*-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the *U*-factor in Table R402.1.2.~~

~~**R402.1.2-4 R-value computation.** *Cavity insulation* alone shall be used to determine compliance with the *cavity insulation R*-value requirements in Table R402.1.3. *Insulation R*-value shall be determined as specified in Section R303.1.4. *Insulation material used in layers, such as framing cavity insulation or continuous insulation, Where cavity insulation is installed in multiple layers, the R-values of the cavity insulation layers shall be summed to compute the corresponding component determine compliance with the cavity insulation R-value requirements.* The manufacturer's settled *R*-value shall be used for blown insulation. *Continuous insulation (ci) alone shall be used to determine compliance with the continuous insulation R-value requirements in Table R402.1.3. Where continuous insulation is installed in multiple layers, the R-values of the continuous insulation layers shall be summed to determine compliance with the continuous insulation R-value requirements. Cavity insulation R-values shall not be used to determine compliance with the continuous insulation R-value requirements in Table R402.1.3.* 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 R402.1.4~~3~~, the manufacturer's labeled *R*-value for insulated siding shall be reduced by *R*-0.6.~~

~~**R402.1.3 U factor alternative.** An assembly with a *U* factor equal to or less than that specified in Table R402.1.3 shall be permitted as an alternative to the *R*-value in Table R402.1.1. *U*-factors shall be determined as specified in Section R402.1.5.~~

**TABLE R402.1.3  
EQUIVALENT U-FACTORS<sup>a</sup> INSULATION MINIMUM R-VALUES AND FENESTRATION  
REQUIREMENTS BY COMPONENTS<sup>a</sup>**

| CLIMATE ZONE 5 AND MARINE 4   |       |
|-------------------------------|-------|
| Fenestration U-Factor         | 0.30  |
| Skylight U-Factor             | 0.50  |
| Ceiling U-Factor              | 0.026 |
| Above-Grade Wall U-Factor     | 0.056 |
| Floor U-Factor                | 0.029 |
| Slab on-Grade F-Factor        | 0.54  |
| <b>Below-Grade 2'-Depth</b>   |       |
| Wall U-Factor                 | 0.042 |
| Slab F-Factor                 | 0.59  |
| <b>Below-Grade 3.5'-Depth</b> |       |
| Wall U-Factor                 | 0.040 |
| Slab F-Factor                 | 0.56  |
| <b>Below-Grade 7'-Depth</b>   |       |
| Wall U-Factor                 | 0.035 |
| Slab F-Factor                 | 0.50  |

- a. ~~*U*-factors or *F*-factors shall be obtained from measurement, calculation or an approved source, or as specified in Section R402.1.5.~~

| <b>CLIMATE ZONE 5 AND MARINE 4</b>            |                                               |
|-----------------------------------------------|-----------------------------------------------|
| <b>Fenestration U-Factor<sup>b,i</sup></b>    | <u>0.30</u>                                   |
| <b>Skylight<sup>b</sup> U-Factor</b>          | <u>0.50</u>                                   |
| <b>Ceiling R-Value<sup>e</sup></b>            | <u>49</u> <del>60</del>                       |
| <b>Wood Frame Wall<sup>g,h</sup> R-Value</b>  | <u>21 int</u> <del>20+5</del> or <u>13+10</u> |
| <b>Floor R-Value</b>                          | <u>30</u>                                     |
| <b>Below-Grade<sup>c,h</sup> Wall R-value</b> | <u>10/15/21 int + 5TB</u>                     |
| <b>Slab<sup>d,f</sup> R-Value &amp; Depth</b> | <u>10, 2 ft</u> <del>10, 4 ft</del>           |

- a. R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the compressed R-value of the insulation from Appendix Table A101.4 shall not be less than the R-value specified in the table.
- b. The fenestration U-factor column excludes skylights.
- c. "10/15/21 +5TB" means R-10 continuous insulation on the exterior of the wall, or R-15 continuous insulation on the interior of the wall, or R-21 cavity insulation plus a thermal break between the slab and the basement wall at the interior of the basement wall. "10/15/21 +5TB" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the wall. "5TB" means R-5 thermal break between floor slab and basement wall.
- d. R-10 continuous insulation is required under heated slab on grade floors. See Section R402.2.9.1.
- e. For single rafter- or joist-vaulted ceilings, the insulation may be reduced to R-38 if the full insulation depth extends over the top plate of the exterior wall.
- f. R-7.5 continuous insulation installed over an existing slab is deemed to be equivalent to the required perimeter slab insulation when applied to existing slabs complying with Section R503.1.1. If foam plastic is used, it shall meet the requirements for thermal barriers protecting foam plastics.
- g. For log structures developed in compliance with Standard ICC 400, log walls shall meet the requirements for climate zone 5 of ICC 400.
- h. Int. (intermediate framing) denotes framing and insulation as described in Section A103.2.2 including standard framing 16 inches on center, 78 percent of the wall cavity insulated and headers insulated with a minimum of R-10 insulation.
- i. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "R13+10" means R-13 cavity insulation plus R-10 continuous insulation.
- j. A maximum U-factor of 0.32 shall apply to vertical fenestration products installed in buildings located above 4000 feet in elevation above sea level, or in windborne debris regions where protection of openings is required under Section R301.2.1.2 of the International Residential Code.

**R402.1.5 Total UA alternative.** If the proposed *building thermal envelope* UA is less than or equal to the target UA, the building shall be considered in compliance with Table R402.1.42. The proposed UA shall be calculated in accordance with Equation 2. The target UA shall be calculated in accordance with Equation 1. U-factors shall be determined as specified in Section R402.1.56. In addition to UA compliance, the maximum fenestration U-factors of Section R402.5 shall be met.

**R402.1.6 U-factor reference and calculations.** The U-factors for typical construction assemblies are included in Appendix A in chapter 51-11C WAC. These values shall be used for all calculations. Where proposed construction assemblies are not represented in Appendix A, values shall be calculated in accordance with the ASHRAE *Handbook of Fundamentals* using the framing factors listed in Appendix A where applicable and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance. Fenestration U-factors shall comply with Section R303.1.3, Fenestration product rating.

~~**R402.1.6 Vapor retarder.** 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.~~

**EQUATION 1 — GROUP R OCCUPANCY  
TARGET UA**

$$UA_T = U_W A_W + U_{BGW} A_{BGW} + U_{VG} A_{VG} + U_{OG} A_{OG} + U_F A_F + U_{RC} A_{RC} + U_D A_D + F_S P_S + F_{BGS} P_{BGS}$$

**Where:**

- $UA_T$  = the target combined thermal transmittance of the gross exterior wall, floor and roof/ceiling area.
- $U_W$  = the thermal transmittance value of the opaque above grade wall found in Table R402.1.32.
- $A_W$  = opaque above grade wall area.
- $U_{BGW}$  = the thermal transmittance value of the below grade opaque wall found in Table R402.1.32.
- $A_{BGW}$  = opaque below grade wall area.
- $U_{VG}$  = the thermal transmittance value of the fenestration found in Table R402.1.32.
- $A_{VG}$  = (a) The proposed glazing area; where proposed fenestration glazing area is less than 15% of the conditioned floor area, minus  $A_{OG}$ .  
(b) 15% of the conditioned floor area; where the proposed fenestration glazing area is 15% or more of the conditioned floor area, minus  $A_{OG}$ .
- $U_{OG}$  = the thermal transmittance value of the skylight glazing found in Table R402.1.32.
- $A_{OG}$  = skylight glazing area (if the proposed  $A_{OG}$  exceeds 15 percent, the target  $A_{OG}$  shall be 15 percent of the total floor area of the conditioned space).
- $U_F$  = the thermal transmittance value of the floor found in Table R402.1.32.
- $A_F$  = floor area over unconditioned space.
- $U_{RC}$  = the thermal transmittance value of the ceiling found in Table R402.1.32.
- $A_{RC}$  = roof/ceiling area.
- $U_D$  = the thermal transmittance value of the fenestration found in Table R402.1.32.
- $A_D$  = opaque door area.
- $F_S$  = concrete slab on grade component F-factor found in Table R402.1.32.
- $P_S$  = lineal ft. of concrete slab on grade perimeter.
- $F_{BGS}$  = concrete below grade slab component F-factor found in Table R402.1.32.
- $P_{BGS}$  = lineal ft. of concrete below grade slab perimeter.

**EQUATION 2 — GROUP R OCCUPANCY  
PROPOSED UA**

$$UA = U_W A_W + U_{BGW} A_{BGW} + U_{VG} A_{VG} + U_{OG} A_{OG} + U_F A_F + U_{RC} A_{RC} + U_D A_D + F_S P_S + F_{BGS} P_{BGS}$$

**Where:**

- UA = the combined thermal transmittance of the gross exterior wall, floor and roof/ceiling assembly area.
- $U_W$  = the thermal transmittance of the opaque above grade wall area.
- $A_W$  = opaque above grade wall area.
- $U_{BGW}$  = the thermal transmittance value of the below grade opaque wall.
- $A_{BGW}$  = opaque below grade wall area.
- $U_{VG}$  = the thermal transmittance value of the fenestration glazing.
- $A_{VG}$  = fenestration glazing area, including windows in exterior doors.
- $U_{OG}$  = the thermal transmittance value of the skylight glazing.
- $A_{OG}$  = skylight glazing area.
- $U_F$  = the thermal transmittance of the floor.
- $A_F$  = floor area over unconditioned space.
- $U_{RC}$  = the thermal transmittance of the ceiling.
- $A_{RC}$  = ceiling area.
- $U_D$  = the thermal transmittance value of the opaque door area.
- $A_D$  = opaque door area.
- $F_S$  = concrete slab on grade component F-factor.
- $P_S$  = lineal ft. of concrete slab on grade perimeter.
- $F_{BGS}$  = concrete below grade slab component F-factor.
- $P_{BGS}$  = lineal ft. of concrete below grade slab perimeter.

**NOTE:** Where more than one type of wall, window, roof/ceiling, door and skylight is used, the U and A terms for those items shall be expanded into sub-elements as:

$$U_{W1} A_{W1} + U_{W2} A_{W2} + U_{W3} A_{W3} + \dots \text{etc.}$$

**NOTE:** Below Grade Walls: The wall is assumed to extend from the slab upward to the top of the mud sill for the distance specified in Table A104.1, with 6 inches of concrete wall extending above grade. This will be calculated separately from above grade walls using the wall height that best describes the system.

**R402.2 Specific insulation requirements.** In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections R402.2.1 through R402.2.10.

**R402.2.1 Ceilings with attic spaces.** Where Section R402.1.43 would require R-49-60 in the ceiling ~~or attic~~, installing R-38-49 over 100 percent of the ceiling area requiring insulation shall ~~be deemed to~~ satisfy the requirement for R-49-60 wherever the full height of uncompressed R-38-49 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the ~~U-factor alternative approach~~ insulation and fenestration criteria in Section R402.1.32 and the Total UA alternative in Section R402.1.45.

**R402.2.1.1 Loose insulation in attic spaces.** Open-blown or poured loose fill insulation may be used in attic spaces where the slope of the ceiling is not more than 3 feet in 12 and there is at least 30 inches of clear distance from the top of the bottom chord of the truss or ceiling joist to the underside of the sheathing at the roof ridge.

**R402.2.2 Reserved.**

**R402.2.3 Eave baffle.** For ~~air-air~~-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain ~~an a~~ net free area opening equal to 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. The baffle shall be installed to the outer edge of the exterior wall top plate so as to provide maximum space for attic insulation coverage over the top plate. Where soffit venting is not continuous, baffles shall be installed continuously to prevent ventilation air in the eave soffit from bypassing the baffle.

**R402.2.4 Access hatches and doors.** Access hatches and doors from *conditioned spaces* to *unconditioned spaces* such as (e.g., attics and crawl spaces) shall be ~~weatherstripped and~~ insulated to the same R-value required by table R402.1.3 for the wall or ceiling in which they are installed, 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 wood framed 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.~~

**Exception:** Vertical doors ~~that provide providing~~ access from *conditioned spaces* to *unconditioned spaces* ~~shall be permitted to meet that comply with~~ the fenestration requirements of Table R402.1.43.

**R402.2.4.1 Access hatches and door insulation installation and retention.** Vertical or horizontal access hatches and doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped. Access that a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation shall be provided to all equipment. A wood framed or equivalent baffle or retainer is required to be provided when Where loose fill insulation is installed, a wood framed or equivalent baffle or retainer, or dam shall be installed to prevent the loose-fill insulation the purpose of which is to prevent the loose fill insulation from spilling into the living spaces, from higher to lower sections of the attic and from attics covering conditioned spaces to unconditioned spaces. The baffle or retainer shall 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.** Mass walls, where used as a component of the building thermal envelope of a building shall be one of the following:

1. ~~Constructed of~~ Above-grade walls of concrete block, concrete, insulated concrete form, masonry cavity, brick but not brick veneer, adobe, compressed earth block, rammed earth, mass timber, ~~solid timber~~, or solid logs.
2. Any wall having a heat capacity greater than or equal to 6 Btu/ft<sup>2</sup> x °F (123 kJ/m<sup>3</sup> x K).

**R402.2.6 Steel-frame ceilings, walls, and floors.** Steel-frame ceilings, walls, and floors shall comply with the U-factor requirements of Table ~~R402.1.3~~ R402.1.2.

**R402.2.7 Floors.** Floor ~~framing cavity insulation~~ shall comply with one of the following:

1. Insulation shall be installed to maintain permanent contact with the underside of the subfloor

decking in accordance with manufacturer instructions to maintain required R-value or readily fill the available cavity space. Insulation supports shall be installed so spacing is no more than 24-inches on center. Foundation vents shall be placed so that the top of the vent is below the lower surface of the floor insulation.

2. Floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing separating the cavity and the unconditioned space below. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.

4.3. A combination of cavity and continuous insulation shall be installed so that the cavity insulation is in contact with the top side of the continuous insulation that is installed on the underside of the floor framing separating the cavity and the unconditioned space below. The combined R-value of the cavity and continuous insulation shall equal the required R-value for floors. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.

**Exceptions:**

~~1.— 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 R-value in Table R402.1.1 and extends from the bottom to the top of all perimeter floor framing members.~~

~~2.1.~~ When foundation vents are not placed so that the top of the vent is below the lower surface of the floor insulation, a permanently attached baffle shall be installed at an angle of 30° from horizontal, to divert air flow below the lower surface of the floor insulation.

~~3.2.~~ Substantial contact with the surface being insulated is not required in enclosed floor/ceiling assemblies containing ducts where full R-value insulation is installed between the duct and the exterior surface.

**R402.2.8 Below-grade walls.** Below-grade exterior wall insulation used on the exterior (cold) side of the wall shall extend from the top of the below-grade wall to the top of the footing and shall be approved for below-grade use. Above-grade insulation shall be protected. Insulation used on the interior (warm) side of the wall shall extend from the top of the below-grade wall to the below-grade floor level and shall include R-5 rigid board providing a thermal break between the concrete wall and the slab.

**R402.2.9 Slab-on-grade floors.** The minimum thermal resistance (*R*-value) of the insulation around the perimeter of unheated or heated slab-on-grade floors shall be as specified in Table ~~R402.1.1~~R402.1.3. The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. A two-inch by two-inch (maximum) pressure treated nailer may be placed at the finished floor elevation for attachment of interior finish materials. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil.

**R402.2.9.1 Heated slab-on-grade floors.** The entire area of a heated slab-on-grade floor shall be thermally isolated from the soil with a minimum of R-10 insulation. The insulation shall be an approved product for its intended use. If a soil gas control system is present below the heated slab-on-grade floor, which results in increased convective flow below the heated slab-on-grade floor, the heated slab-on-grade floor shall be thermally isolated from the sub-slab gravel layer. R-10 heated slab-on-grade floor insulation is required for all compliance paths.

**R402.2.10 Masonry veneer.** Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

**R402.3 Fenestration.** In addition to the requirements of Section R402, fenestration shall comply with Sections R402.3.1 through R402.3.5.

**R402.3.1 U-factor.** An area-weighted average of fenestration products shall be permitted to satisfy the *U*-factor requirements.

**R402.3.2 Glazed fenestration SHGC.** An area-weighted average of fenestration products more than 50 percent glazed shall be permitted to satisfy the SHGC requirements.



**R402.3.3 Glazed fenestration exemption.** Up to 15 square feet (1.4 m<sup>2</sup>) of glazed fenestration per dwelling unit shall be permitted to be exempt from *U*-factor and SHGC requirements in Section ~~R402.1.1~~R402.1.2. This exemption shall not apply to the *U*-factor alternative approach insulation and fenestration criteria in Section R402.1.3~~R402.1.2 and the~~ Total UA alternative in Section R402.1.45.

**R402.3.4 Opaque door exemption.** 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 R402.1.42. This exemption shall not apply to ~~the *U*-factor alternative approach in Section R402.1.3 and the~~ Total UA alternative in Section ~~R402.1.4~~R402.1.5.

**R402.3.5 Reserved.**

**R402.4 Air leakage.** The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.46.

**R402.4.1 Building thermal envelope.** The *building thermal envelope* shall comply with Sections R402.4.1.1 ~~and R402.4.1.2~~through R402.4.1.3. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

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

**R402.4.1.2 Testing.** The building or dwelling unit shall be tested ~~and verified as having an air leakage rate of not exceeding for air leakage. The maximum air leakage rate for any building or dwelling unit under any compliance path shall not exceed 5.0~~ air changes per hour. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). For this test only, the volume of the home shall be the conditioned floor area in ft<sup>2</sup> (m<sup>2</sup>) multiplied by 8.5 feet (2.6 m). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*. Once visual inspection has confirmed sealing (see Table R402.4.1.1), operable windows and doors manufactured by *small business* shall be permitted to be sealed off at the frame prior to the test.

**Exception:** For dwelling units that are accessed directly from the outdoors, other than detached one family dwellings and townhouses, an air leakage rate not exceeding 0.4 cfm per square foot of the dwelling unit enclosure area shall be an allowable alternative. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals) in accordance with RESNET/ICC 380, ASTM E779 or ASTM E1827. For the purpose of this test only, the enclosure area is to be calculated as the perimeter of the dwelling unit, measured to the outside face of the exterior walls, and the centerline of party walls, times 8.5 feet, plus the ceiling and floor area. Doors and windows of adjacent dwelling units (including top and bottom units) shall be open to the outside during the test. This exception is not permitted for dwelling units that are accessed from corridors or other enclosed common areas.

During testing:

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

**Exceptions:**

1. Additions less than 500 square feet of conditioned floor area.
2. Additions tested with the existing home having a combined maximum air leakage rate of 7 air changes per hour. To qualify for this exception, the date of construction of the existing house must be prior to the 2009 Washington State Energy Code.

~~R402.4.1.3 Leakage rate. When complying with Section R401.2 Option 1, the building or dwelling unit shall have an air leakage rate not exceeding 3.0 air changes per hour when tested in accordance with Section R402.4.1.2.~~

**TABLE R402.4.1.1  
AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION<sup>a</sup>**

| COMPONENT                      | AIR BARRIER CRITERIA <sup>a</sup>                                                                                                                                                                                                           | INSULATION CRITERIA <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General Requirements           | <p>A continuous air barrier shall be installed in the building envelope.</p> <p><del>Exterior thermal envelope contains a continuous air barrier.</del></p> <p>Breaks or joints in the air barrier shall be sealed.</p>                     | <p>Air-permeable insulation shall not be used as a sealing material.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Cavity insulation installation |                                                                                                                                                                                                                                             | <p>All cavities in the thermal envelope shall be filled with insulation. The density of the insulation shall be at the manufacturers' product recommendation and said density shall be maintained for all volume of each cavity. Batt type insulation will show no voids or gaps and maintain an even density for the entire cavity. Batt insulation shall be installed in the recommended cavity depth. Where an obstruction in the cavity due to services, blocking, bracing or other obstruction exists, the batt product will be cut to fit the remaining depth of the cavity. Where the batt is cut around obstructions, loose fill insulation shall be placed to fill any surface or concealed voids, and at the manufacturers' specified density. Where faced batt is used, the installation tabs must be stapled to the face of the stud. There shall be no compression to the batt at the edges of the cavity due to inset stapling installation tabs.</p> <p>Insulation that upon installation readily conforms to available space shall be installed filling the entire cavity and within the manufacturers' density recommendation.</p> |
| Ceiling/attic                  | <p>The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed.</p> <p>Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.</p> | <p>The insulation in any dropped ceiling/soffit shall be aligned with the air barrier</p> <p>Batt insulation installed in attic roof assemblies may be compressed at exterior wall lines to allow for required attic ventilation.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Walls                          | <p>The junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Knee walls shall be sealed.</p>                                                                  | <p>Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|                              |                                                                                            |                                                                                                                                                                                                                 |
|------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              |                                                                                            | material having a thermal resistance of R-3 per inch minimum.<br>Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. |
| Windows, skylights and doors | The space between window/door jambs and framing and skylights and framing shall be sealed. |                                                                                                                                                                                                                 |

**TABLE R402.4.1.1 (continued)**  
**AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION<sup>a</sup>**

| <b>COMPONENT</b>                                        | <b>AIR BARRIER CRITERIA<sup>a</sup></b>                                                                                                                                                                                                                                                                                                                                                                                            | <b>INSULATION CRITERIA<sup>a</sup></b>                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rim Joists                                              | Rim joists shall include <del>the an exterior</del> air barrier <sup>2</sup> .<br><u>The junctions of the rim board to the sill plate and the rimboard and the subfloor shall be air sealed.</u>                                                                                                                                                                                                                                   | Rim joists shall be insulated <u>so that the insulation maintains permanent contact with the exterior rim board<sup>b</sup>.</u>                                                                                                                                                                                                                                                                                                                                   |
| Floors (including above garage and cantilevered floors) | The air barrier shall be installed at any exposed edge of insulation.                                                                                                                                                                                                                                                                                                                                                              | Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking or floor framing cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the underside of floor framing and extend from the bottom to the top of all perimeter floor framing members.                                                                                    |
| <u>Basement, crawl space walls and slab foundations</u> | Exposed earth in unvented crawl spaces shall be covered with a Class I, black vapor retarder with overlapping joints taped.<br><u>Penetrations through concrete foundation walls and slabs shall be air sealed.</u><br><u>Class I vapor retarders shall not be used as an air barrier on <del>below-grade</del> basement walls and shall be installed in accordance with Section R702.7 of the International Residential Code.</u> | <del>Where provided instead of floor insulation, insulation shall be permanently attached to the crawl space walls.</del><br><u>Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab on grade floor insulation shall be installed in accordance with Section R402.2.10.</u> |
| Shafts, penetrations                                    | Duct <del>shafts, utility penetrations,</del> and flue shafts <del>opening</del> to exterior or unconditioned space shall be <u>air sealed.</u><br><u>Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion and contraction of materials and mechanical vibration.</u>                                                                                              | <u>Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required R-value.</u>                                                                                                                                                                                                                                                                                                  |
| Narrow cavities                                         | <u>Narrow cavities, of an inch or less, not able to be insulated, shall be air sealed.</u>                                                                                                                                                                                                                                                                                                                                         | Batts in narrow cavities shall be cut to fit and installed to the correct density without any voids or gaps or compression, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.                                                                                                                                                                                                                  |
| Garage separation                                       | Air sealing shall be provided between the garage and conditioned spaces.                                                                                                                                                                                                                                                                                                                                                           | <u>Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.8.</u>                                                                                                                                                                                                                                                                                                                                      |

|                                                       |                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Recessed lighting                                     | Recessed light fixtures installed in the building thermal envelope shall be <u>air sealed to the finished surface in accordance with Section R402.4.5.</u>                                                                                                     | Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated <u>and shall be buried or surrounded with insulation.</u>                                                                                                                                                                                                                                                                                                                                                                             |
| Plumbing, <del>and wiring or other obstructions</del> | <u>All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.</u>                                                                                                                                            | Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls. There shall be no voids or gaps or compression where cut to fit. Insulation that on installation readily conforms to available space shall extend behind piping and wiring. <u>Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required R-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.</u> |
| Shower/tub on exterior wall                           | The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the showers and tubs.                                                                                                                                    | Exterior walls adjacent to showers and tubs shall be insulated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Electrical/phone box on exterior wall                 | The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| HVAC register boots                                   | HVAC supply and return register boots shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Concealed sprinklers                                  | When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

IC = insulation contact

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

~~a-b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.~~

**R402.4.2 Fireplaces.** New wood-burning fireplaces shall have tight-fitting flue dampers or doors and outdoor combustion air. When using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. When using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

**R402.4.2.1 Gas fireplace efficiency.** All gas fireplace heaters rated to ANSI Z21.88 shall be listed and labeled with a fireplace efficiency (FE) rating of 50 percent or greater in accordance with CSA P.4.1. Vented gas fireplaces (decorative appliances) certified to ANSI Z21.50 shall be listed and labeled, including their FE ratings, in accordance with CSA P.4.1.

**R402.4.3 Air leakage of fenestration.** Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m<sup>2</sup>), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m<sup>2</sup>), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and *listed* and *labeled* by the manufacturer.

**Exceptions:**

1. Field-fabricated fenestration products (windows, skylights and doors).
2. Custom exterior fenestration products manufactured by a small business provided they meet the applicable provisions of Chapter 24 of the *International Building Code*. Once visual inspection has confirmed the presence of a gasket, operable windows and doors manufactured by *small business* shall be permitted to be sealed off at the frame prior to the test.

**R402.4.4 Combustion air openings.** Where open combustion air ducts provide combustion air to open

combustion, space conditioning fuel burning appliances, the appliances and combustion air openings shall be located outside of 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 ~~R402.4.1~~R402.1.3, where the walls, floors and ceilings shall meet the minimum of the below-grade 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.** Recessed luminaires installed in the *building thermal envelope* shall be Type IC-rated and certified under ASTM E283 as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested at a 1.57 psf (75 Pa) pressure differential and shall have a label attached showing compliance with this test method. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

**R402.4.6 Electrical and communication outlet boxes (air-sealed boxes).** Electrical and communication outlet boxes installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. Electrical and communication outlet boxes shall be tested in accordance with NEMA OS 4, Requirements for Air-Sealed Boxes for Electrical and Communication Applications, and shall have an air leakage rate of not greater than 2.0 cubic feet per minute (0.944 L/s) at a pressure differential of 1.57 psf (75 Pa). Electrical and communication outlet boxes shall be marked “NEMA OS 4” or “OS 4” in accordance with NEMA OS 4. Electrical and communication outlet boxes shall be installed per the manufacturer’s instructions and with any supplied components required to achieve compliance with NEMA OS 4.

**R402.5 Maximum fenestration U-factor.** The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section ~~R402.4.4~~R402.1.5 or R405 shall be 0.48 for vertical fenestration, and 0.75 for skylights.

**Exception:** The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall not be required in storm shelters complying with ICC 500.

## SECTION R403 SYSTEMS

**R403.1 Controls.** At least Not less than one thermostat shall be provided for each separate heating and cooling system.

**R403.1.1 Programmable or connected thermostat.** Where the primary heating system is a forced-air furnace, at least one thermostat per dwelling unit shall be Energy Star certified and capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day and different days of the week. The thermostat shall allow for, at a minimum, a 5-2 programmable schedule (weekdays/weekends) and be capable of providing at least two programmable setback/setup periods per day. This thermostat shall include the capability to set back, set up 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 initially by the manufacturer with a heating temperature set point ~~no higher of not greater~~ than 70°F (21°C) and a cooling temperature set point ~~no lower of not less~~ than 78°F (26°C). The thermostat and/or control system shall have an adjustable deadband of not less than 10°F.

**Exceptions:**

1. Systems controlled by an occupant sensor that is capable of shutting the system off when no occupant is sensed for a period of up to 30 minutes.
2. Systems controlled solely by a manually operated timer capable of operating the system for no more than two hours.
3. Ductless mini-split heat pump systems that have an integral proprietary thermostat.



**R403.1.2 Heat pump supplementary heat.** Unitary air cooled heat pumps shall include controls that minimize supplemental heat usage during start-up, set-up, and defrost conditions. These controls shall anticipate need for heat and use compression heating as the first stage of heat. Controls shall indicate when supplemental heating is being used through visual means (e.g., LED indicators). Heat pumps equipped with supplementary heaters shall be installed with controls that prevent supplemental heater operation above 40°F. At final inspection the auxiliary heat lock out control shall be set to 35°F or less.

**R403.1.3 Continuously burning pilot lights.** The natural gas systems and equipment listed below are not permitted to be equipped with continuously burning pilot lights.

1. Fan-type central furnaces.
2. Household cooking appliances.

**Exception:** Household cooking appliances without electrical supply voltage connections and in which each pilot light consumes less than 150 Btu/hr.

3. Pool heaters.
4. Spa heaters.
5. Fireplaces

**Exception:** Any fireplace with on-demand, intermittent or interrupted ignition (as defined in ANSI Z21.20) is not considered continuous.

**R403.2 Hot water boiler ~~outdoor temperature setback reset.~~** ~~Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor temperature setback control that lowers the boiler water temperature based on the outdoor temperature. The manufacturer shall equip~~ configure each gas, oil and electric boiler (other than a boiler equipped with a tankless domestic water heating coil) with an automatic means of adjusting the water temperature supplied by the boiler to ensure incremental change of the inferred heat load will cause an incremental change in the temperature of the water supplied by the boiler. This can be accomplished with outdoor reset, indoor reset or water temperature sensing.

**R403.3 Ducts.** Ducts and air handlers shall be installed in accordance with Sections R403.3.1 through R403.3.7.

**R403.3.1 ~~Insulation~~Ducts located outside conditioned space.** ~~Ducts outside the building thermal envelope shall be insulated to a minimum of R-8. Ducts within a concrete slab or in the ground shall be insulated to R-10 with insulation designed to be used below grade. Supply and return ducts located outside conditioned space shall be insulated to and R-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. Ducts buried beneath a building shall be insulated as required per this section or have an equivalent thermal distribution efficiency. {Ducts within a concrete slab or in the ground shall be insulated to R-10 with insulation designed to be used below grade.} Underground ducts utilizing the thermal distribution efficiency method shall be listed and labeled to indicate the R-value equivalency.~~

**Exception:** ~~Ducts or portions thereof located completely inside the building thermal envelope. Ducts located in crawl spaces do not qualify for this exception.~~

**~~R403.3.7~~R403.3.2 Ducts located in conditioned space.** For ducts to be considered as inside a conditioned space, such ducts shall comply with either of the following:

1. All duct systems shall be located completely within the continuous air barrier and within the building thermal envelope.
2. All heating, cooling and ventilation system components shall be installed inside the conditioned space including, but not limited to, forced air ducts, hydronic piping, hydronic floor heating loops, convectors and radiators. Combustion equipment shall be direct vent or sealed combustion.
3. For forced air ducts, a maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts is permitted to be located outside the conditioned space, provided they are insulated to a minimum of R-8.
  - 3.1. Metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic.

- 3.2. If flex ducts are used, they cannot contain splices. Flex duct connections must be made with nylon straps and installed using a plastic strapping tensioning tool.
4. Ductwork in floor cavities located over unconditioned space shall comply with all of the following:
- 4.1. A continuous air barrier installed between unconditioned space and the duct.
  - 4.2. Insulation installed in accordance with Section R402.2.7.
  - 4.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.
5. Ductwork located within exterior walls of the building thermal envelope shall comply with the following:
- 5.1. A continuous air barrier installed between unconditioned space and the duct.
  - 5.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.
  - 5.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

**R403.3.63 Ducts buried within ceiling insulation.** Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

- 1. The supply and return ducts shall have an insulation R-value not less than R-8.
- 2. At all points along each duct, the sum of the ceiling insulation R-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the R-value of the duct insulation.

**Exception:** Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

**R403.3.63.1 Effective R-value of deeply buried ducts.** Where using a simulated energy performance analysis, sections of ducts that are: installed in accordance with Section R403.3.63; located directly on, or within 5.5 inches (140 mm) of the ceiling; surrounded with blown-in attic insulation having an R-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation R-value of R-25.

**R403.3.24 Sealing.** 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.

**R403.3.24.1 Sealed air handler.** 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.

**R403.3.35 Duct testing.** Ducts shall be leak tested in accordance with WSU RS-33, using the maximum duct leakage rates specified.

**Exceptions:**

- ~~1. The total leakage test or leakage to the outdoors is not required for ducts and air handlers located entirely within the building thermal envelope. For forced air ducts, a maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts may be located outside the conditioned space. All metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic. If flex ducts are used, they cannot contain splices. Flex duct connections must be made with nylon straps and installed using a plastic strapping tensioning tool. Ducts located in crawl spaces do not qualify for this exception.~~
- 2. A duct air leakage test shall not be required for ducts serving **heat or energy recovery ventilators/ventilation systems** that are not integrated with ducts serving heating or cooling



systems.

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

**R403.3.46 Duct leakage.** The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

1. Rough-in test: Total leakage shall be less than or equal to 4.0 cfm (113.3 L/min) per 100 square feet (9.29 m<sup>2</sup>) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure. All registers shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 3.0 cfm (85 L/min) per 100 square feet (9.29 m<sup>2</sup>) of conditioned floor area.
2. Postconstruction test: Leakage to outdoors shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m<sup>2</sup>) of conditioned floor area or total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m<sup>2</sup>) 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.

2.3. Test for ducts within thermal envelope: The total leakage test or leakage to the outdoors is not required for Where all ducts and air handlers are located entirely within the building thermal envelope, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m<sup>2</sup>) of conditioned floor area. For forced air ducts, a maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts may be located outside the conditioned space. All metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic. If flex ducts are used, they cannot contain splices. Flex duct connections must be made with nylon straps and installed using a plastic strapping tensioning tool. Ducts located in crawl spaces do not qualify for this exception.

**R403.3.57 Building cavities.** Building framing cavities shall not be used as ducts or plenums. Installation of ducts in exterior walls, floors or ceilings shall not displace required envelope insulation.

~~**R403.3.6 Ducts buried within ceiling insulation.** Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:~~

- ~~1. The supply and return ducts shall have an insulation R value not less than R-8.~~
- ~~2.1. At all points along each duct, the sum of the ceiling insulation R value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the R value of the duct insulation.~~

~~**Exception:** Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.~~

~~**R403.3.6.1 Effective R value of deeply buried ducts.** Where using a simulated energy performance analysis, sections of ducts that are: installed in accordance with Section R403.3.6; located directly on, or within 5.5 inches (140 mm) of the ceiling; surrounded with blown-in attic insulation having an R value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation R value of R-25.~~

~~**R403.3.7 Ducts located in conditioned space.** For ducts to be considered as inside a conditioned space, such ducts shall comply with either of the following:~~

- ~~1. All duct systems shall be located completely within the continuous air barrier and within the building thermal envelope.~~
- ~~2.1. All heating, cooling and ventilation system components shall be installed inside the conditioned space including, but not limited to, forced air ducts, hydronic piping, hydronic floor heating loops, convectors and radiators. Combustion equipment shall be direct vent or sealed combustion.~~
- ~~3.1. For forced air ducts, a maximum of 10 linear foot of return ducts and 5 linear feet of supply ducts is permitted to be located outside the conditioned space, provided they are insulated to a minimum of R-8.~~

~~3.1.1.1. Metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic.~~

~~3.2.1.1. If flex ducts are used, they cannot contain splices. Flex duct connections must be made with nylon straps and installed using a plastic strapping tensioning tool.~~

**R403.4 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-6.

**Exception:** Up to 200 feet of hydronic system piping installed within the conditioned space may be insulated with a minimum of ½-inch insulation with a *k* value of 0.28.

**R403.4.1 Protection of piping insulation.** 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.** Energy conservation measures for service hot water systems shall be in accordance with Sections R403.5.1 through R403.5.5. Service water-heating equipment shall meet the requirements of DOE 10 CFR Part 430 Uniform Energy Factor or the equipment shall meet the requirements of Section C404.2.

**R403.5.1 Heated water circulation and temperature maintenance systems.** 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 in a location with access. Manual controls shall be readily accessible in a location with ready access.

**R403.5.1.1 Circulation systems.** 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 thermo-syphon 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. The controls shall limit the temperature of the water entering the cold water piping to not greater than 104° F (40°C).

**R403.5.2 Demand recirculation water systems.** Where installed, demand recirculation water systems shall have controls that comply with both of the following: 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.

~~— The controls 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.~~

~~— The controls shall limit the temperature of the water entering the cold water piping to not greater than 104°F (40 °C).~~

**R403.5.1.2 Heat trace systems.** 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 water systems.** Demand recirculation water systems shall have controls that comply with both of the following:~~

~~1. The controls 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.~~

~~2.1. The controls shall limit the temperature of the water entering the cold water piping to not greater than 104°F (40 °C).~~

**R403.5.3<sup>2</sup> Hot water pipe insulation.** Insulation for service hot water pipe, both within and outside the conditioned space, shall have a minimum thermal resistance (*R*-value) of R-3.

**Exception:** Pipe insulation is permitted to be discontinuous where it passes through studs, joists or other structural members and where the insulated pipes pass other piping, conduit or vents, provided the insulation is installed tight to each obstruction.

**R403.5.43 Drain water heat recovery units.** Where installed, drain water heat recovery units shall comply with CSA 55.2 or IAPMO PS 92. Drain water heat recovery units shall be in accordance with CSA 55.1 or IAPMO IGC 346-2017.

**R403.5.54 Electric water heater insulation.** All electric water heaters in unconditioned spaces, or on concrete floors in conditioned spaces, shall be placed on an insulated surface with a minimum thermal resistance of R-10, and a minimum compressive strength of 40 psi or engineered to support the appliance.

**R403.6 Mechanical ventilation.** The buildings complying with Section R402.4.1 shall be provided with mechanical ventilation that meets the requirements of Section M1505 in the International Residential Code or the International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

**R403.6.1 Whole-house-dwelling mechanical ventilation system fan efficacy.** Mechanical ventilation system fans shall meet the efficacy requirements of Table R403.6.1 at one or more rating points. Fans shall be tested in accordance with HVI 916 and listed. The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing on the label. Fan efficacy for fully ducted HRV, ERV, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch w.c. (49.85 Pa). Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 inch w.c. (24.91 Pa).

**Exception:** Where an air handler that is integral to the tested and listed HVAC equipment is used to provide whole-house ventilation, the air handler shall be powered by an electronically commutated motor.

**TABLE R403.6.1  
WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY<sup>a</sup>**

| FAN LOCATION                                                              | AIR FLOW RATE MINIMUM (CFM) | MINIMUM EFFICACY (CFM/WATT)        | AIR FLOW RATE MAXIMUM (CFM) |
|---------------------------------------------------------------------------|-----------------------------|------------------------------------|-----------------------------|
| HRV <del>or</del> ERV                                                     | Any                         | 1.2 cfm/watt                       | Any                         |
| Range hoods                                                               | Any                         | <del>2.8</del> cfm/watt            | Any                         |
| In-line <u>supply or exhaust</u> fan                                      | Any                         | <del>2.8</del> <u>3.8</u> cfm/watt | Any                         |
| <del>Bathroom, utility room</del> <u>Other exhaust fan</u>                | <del>40</del> <u>&lt;90</u> | <del>1.4</del> <u>2.8</u> cfm/watt | <del>&lt;90</del>           |
| <del>Bathroom, utility room</del> <u>Other exhaust fan</u>                | $\geq 90$                   | <del>2.8</del> <u>3.5</u> cfm/watt | Any                         |
| <u>Air handler that is integrated to tested and listed HVAC equipment</u> | Any                         | <u>1.2 cfm/watt</u>                |                             |

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916 Design outdoor or exhaust airflow rate/watts of fan used.

**R403.6.2 Testing.** Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6. Testing shall be performed according to the ventilation equipment manufacturer's instructions, or by using a flow hood or box, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals or grilles, outlet terminals or grilles, or in the connected ventilation ducts. Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

**Exception:** Kitchen range hoods that are ducted to the outside with 6-inch (152 mm) or larger duct

and not more than one 90-degree (1.57 rad) elbow or equivalent in the duct run

**R403.7 Equipment sizing and efficiency rating.** 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 *approved* heating and cooling calculation methodologies. The output capacity of heating and cooling equipment shall not be greater than that of the smallest available equipment size that exceeds the loads calculated, including allowable oversizing limits. Equipment shall meet the minimum federal efficiency standards as referenced in Tables C403.3.2(1), C403.3.2(2), C403.3.2(3), C403.3.2(4), C403.3.2(5), C403.3.2(6), C403.3.2(7), C403.3.2(8) and C403.3.2(9) and tested and rated in accordance with the applicable test procedure.

**R403.7.1 Electric resistance zone heated units.** All detached one- and two-family dwellings and multiple single-family dwellings (townhouses) up to three stories in height above grade plane using electric zonal heating as the primary heat source shall install an inverter-driven ductless mini-split heat pump in the largest zone in the dwelling. Building permit drawings shall specify the heating equipment type and location of the heating system.

**Exception:** Total installed heating capacity of 2 kW per dwelling or less.

**R403.8 Systems serving multiple dwelling units.** Systems serving multiple dwelling units shall comply with Sections C403 and C404 of the WSEC--Commercial Provisions in lieu of Section R403.

**R403.9 Snow melt system controls.** Snow and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F, and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F.

**R403.10 ~~Pool and permanent spa energy consumption~~Energy consumption of pools and spas.** ~~The energy consumption of~~ pools and permanent spas shall ~~comply with~~ be controlled by the requirements in Sections R403.10.1 through R403.10.4.2.

**R403.10.1 Heaters.** The electric power to heaters shall be controlled by a ~~n readily accessible~~ on-off switch that is an integral part of the heater mounted on the exterior of the heater in a location with ready access, or external to and within 3 feet (914 mm) of the heater. Operation of such switch shall not change the settings of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater.

**R403.10.2 Time switches.** Time switches or other control method that can automatically turn off and on heaters and pump motors according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built in time switches shall be deemed in compliance with this requirement.

**Exceptions:**

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar- and waste-heat-recovery pool heating systems.

**R403.10.3 Covers.** Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover, or other *approved* vapor retardant means.

**Exception:** Where more than 75 percent of the energy for heating, computed over an operating season of not ~~less-fewer~~ than three calendar months, is from a heat pump or on-site renewable energy system, covers or other vapor-retardant means shall not be required.

**R403.10.4 Residential pool pumps.** Pool pump motors may not be split-phase or capacitor start-induction run type.

**R403.10.4.1 Two-speed capability.**

1. Pump motors: Pool pump motors with a capacity of 1 hp or more shall have the capability of operating at two or more speeds with low speed having a rotation rate that is no more than one-half of the motor's maximum rotation rate.
2. Pump controls: Pool pump motor controls shall have the capability of operating the pool pump with at least two speeds. The default circulation speed shall be the lowest speed, with a high speed override capability being for a temporary period not to exceed one normal cycle.

**R403.10.4.2 Pump operation.** Circulating water systems shall be controlled so that the circulation pump(s) can be conveniently turned off, automatically or manually, when the water system is not in operation.

**R403.11 Portable spas.** The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP-14.

**R403.12 Residential pools and permanent residential spas.** ~~Residential-Where installed, the energy consumption of 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 controlled in accordance with the requirements of APSP-15.

## SECTION R404 ELECTRICAL POWER AND LIGHTING SYSTEMS

**R404.1 Lighting equipment.** ~~Not less than 90 percent of lamps in-All~~ permanently installed lighting fixtures, ~~excluding kitchen appliance lighting fixtures,~~ shall ~~be contain only~~ high-efficacy lamps ~~lighting sources.~~

**R404.1.1 Exterior lighting.** Connected exterior lighting for residential buildings shall comply with Section C405.5.

**Exceptions:**

~~— Detached one- and two-family dwellings.~~

~~— Townhouses.~~

1. Solar-powered lamps not connected to any electrical service.

~~— Luminaires controlled by a motion sensor.~~

~~— Lamps and luminaires that comply with Section R404.1.~~

**R404.1.2 Fuel gas lighting equipment.** Fuel gas lighting systems shall not have continuously burning pilot lights.

**R404.2 Interior lighting controls.** Permanently installed interior lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture.

**Exception:** Lighting controls shall not be required for the following:

1. Bathrooms.

2. Hallways.

~~— Exterior lighting fixtures.~~

3. Lighting designed for safety or security.

**R404.3 Exterior lighting controls.** Where the total permanently installed exterior lighting power is greater than 30 watts, the permanently installed exterior lighting shall comply with the following:

1. Lighting shall be controlled by a manual on and off switch which permits automatic shut-off actions.

**Exception:** Lighting serving multiple dwelling units.

2. Lighting shall be automatically shut off when daylight is present and satisfies the lighting needs.

3. Controls that override automatic shut-off actions shall not be allowed unless the override automatically returns automatic control to its normal operation within 24 hours.

## SECTION R405 ~~SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)~~TOTAL BUILDING PERFORMANCE

**R405.1 Scope.** This section establishes criteria for compliance using ~~simulated energy-total building~~ performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water heating energy only.

**R405.2 ~~Mandatory requirements~~Performance-based compliance.** ~~Compliance with this section based on total building performance requires that a proposed design meets all of the following: compliance with those sections shown in Table R405.2. All supply and return ducts not completely inside the building~~



*thermal envelope shall be insulated to a minimum of R-8.*

**R405.3 Performance-based compliance.** Compliance based on simulated energy performance requires that a proposed residence (*proposed design*) be shown to have an annual energy consumption based on carbon emissions of the fuels and energy use in the proposed building. Carbon emissions for both the standard reference design and the proposed design shall be calculated using Table R405.3. Energy use derived from simulation analysis shall be expressed in pounds of carbon per square foot of *conditioned floor area* as follows:

1. The requirements of the sections indicated within Table R405.2
- 1.2. For structures less than 1,500 square feet of conditioned floor area, the annual carbon emissions shall be less than or equal to 73 percent of the annual carbon emissions of the *standard reference design*.
- 2.3. For structures 1,500 to 5,000 square feet of conditioned floor area, the annual carbon emissions shall be no more than 56 percent of the *standard reference design*.
- 3.4. For structures over 5,000 square feet of conditioned floor area, the annual carbon emissions shall be no more than 50 percent of the *standard reference design*.
- 4.5. For structures serving Group R-2 occupancies, the annual carbon emissions shall be less than or equal to 70 percent of the annual carbon emissions of the *standard reference design*.

**TABLE R405.2  
MANDATORY COMPLIANCE MEASURES FOR SIMULATED PERFORMANCE ALTERNATIVE**

| Section <sup>a</sup> | Title                                                       | Comments                                |
|----------------------|-------------------------------------------------------------|-----------------------------------------|
| <b>General</b>       |                                                             |                                         |
| R401.3               | Certificate                                                 |                                         |
| <b>Envelope</b>      |                                                             |                                         |
| <u>R402.1.1</u>      | <u>Vapor retarder</u>                                       |                                         |
| <u>R402.2.3</u>      | <u>Eave baffle</u>                                          |                                         |
| <u>R402.2.4.1</u>    | <u>Access hatches and doors</u>                             |                                         |
| <u>R402.2.10.1</u>   | <u>Crawlspace wall insulation installations</u>             |                                         |
| R402.4               | Air leakage                                                 |                                         |
| R402.5               | Maximum fenestration U-factor                               |                                         |
| <b>Systems</b>       |                                                             |                                         |
| R403.1               | Controls                                                    |                                         |
| R403.1.2             | Heat pump supplemental heat                                 |                                         |
| <u>R403.3</u>        | <u>Ducts</u>                                                | <u>Except for R403.3.2 and R403.3.3</u> |
| <u>R403.3.2</u>      | <u>Sealing (now R403.3.4)</u>                               |                                         |
| <u>R403.3.1</u>      | <u>Insulation</u>                                           |                                         |
| <u>R403.3.3</u>      | <u>Duct testing</u>                                         |                                         |
| <u>R403.3.4</u>      | <u>Duct leakage</u>                                         |                                         |
| <u>R403.3.5</u>      | <u>Building cavities</u>                                    |                                         |
| R403.4               | Mechanical system piping insulation                         |                                         |
| R403.5.1             | Heated water circulation and temperature maintenance system |                                         |
| <u>R403.5.3</u>      | <u>Drain water heat recovery units</u>                      |                                         |
| R403.6               | Mechanical ventilation                                      |                                         |
| R403.7               | Equipment sizing and efficiency rating                      |                                         |
| R403.8               | Systems serving multiple dwelling units                     |                                         |

|                                       |                                                                                           |  |
|---------------------------------------|-------------------------------------------------------------------------------------------|--|
| R403.9                                | Snow melt system controls                                                                 |  |
| R403.10                               | <del>Pool and permanent spa energy consumption</del> Energy consumption of pools and spas |  |
| R403.11                               | Portable spas                                                                             |  |
| <del>R403.12</del>                    | <del>Residential pools and permanent residential spas</del>                               |  |
| <b>Electrical Power and Lighting</b>  |                                                                                           |  |
| R404.1                                | Lighting equipment                                                                        |  |
| <del>R404.1.1</del> <del>R404.2</del> | <del>Lighting equipment</del> Interior lighting controls                                  |  |
| <b>Other Requirements</b>             |                                                                                           |  |
| R406                                  | Additional energy efficiency requirements                                                 |  |

a. Reference to a code section includes all the relative subsections except as indicated in the table.

**TABLE R405.3  
CARBON EMISSIONS FACTORS**

| TYPE                     | CO <sub>2</sub> e<br>(lb/unit) | UNIT   |
|--------------------------|--------------------------------|--------|
| Electricity              | <del>0.890</del> .44           | kWh    |
| Natural gas              | 11.7                           | Therm  |
| Oil                      | 19.2                           | Gallon |
| Propane                  | 10.5                           | Gallon |
| Other <sup>a</sup>       | 195.00                         | mmBtu  |
| On-site renewable energy | 0.00                           |        |

a. District energy systems may use alternative emission factors supported by calculations *approved* by the *code official*.

**R405.43 Documentation.** Documentation of the software used for the performance design and the parameters for the building shall be in accordance with Sections R405.43.1 through R405.43.3.

**R405.3.1 Compliance software tools.** Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the *code official*.

**R405.3.2 Compliance report.** Compliance software tools shall generate a report that documents that the *proposed design* complies with Section R405.32. A compliance report on the *proposed design* shall be submitted with the application for the building permit. Upon completion of the building, a confirmed compliance report based on the as-built-confirmed condition of the building shall be submitted to the code official before a certificate of occupancy is issued. ~~Batch sampling of buildings to determine energy code compliance for all buildings in the batch shall be prohibited.~~

Compliance reports shall include information in accordance with Sections R405.43.2.1 and R405.43.2.2. ~~Where the proposed design of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the proposed design for the purposes of the application for the building permit shall be based upon the worst-case orientation, worst-case configuration, worst-case building air leakage and worst-case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.~~

**R405.3.2.1 Compliance report for permit application.** A compliance report submitted with the application for building permit shall include all of the following:

1. Building street address, or other *building site* identification.
2. ~~A statement indicating that the proposed design complies with Section R405.3. The name, organization and contact information of the individual performing the analysis and generating the compliance report.~~
3. ~~An inspection checklist documenting the building component characteristics of the proposed design as indicated in Table R405.5.2(1). The inspection checklist shall show results for both~~



- ~~the standard reference design and the proposed design with all user inputs to the compliance software to generate the results. The name and version of the compliance software tool.~~
4. ~~A site-specific energy analysis report that is in compliance with Section R405.3. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.~~
  5. ~~Name of the individual performing the analysis and generating the report. A certificate indicating that the proposed design complied with Section R405.2. The certificate shall document the building components' energy specifications that are included in the calculation including: component-level insulation R-values or U-factors; duct system and building envelope air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system. Additional documentation reporting estimated annual energy production shall be provided.~~
  6. ~~Name and version of the compliance software tool. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.~~

**R405.3.2.2 Compliance report for certificate of occupancy.** A compliance report submitted for obtaining the certificate of occupancy shall include all of the following:

1. Building street address, or other building site identification
- 1.2. ~~Declaration of the total building performance path on the title page of the energy report and the title page of the building plans.~~
- 2.3. ~~A statement, bearing the name of the individual performing the analysis and generating the report, along with their organization and contact information, indicating that the as-built building complies with Section R405.3.2.~~
- 3.4. ~~A certificate indicating that the building passes the performance matrix for code compliance and the energy saving features of the buildings. The name and version of the compliance software tool.~~
- 4.5. A site-specific energy analysis report that is in compliance with Section R405.3.2.
- 5.6. ~~Name of the individual performing the analysis and generating the report. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.2. The certificate shall report the energy features that were confirmed to be in the home, including component level insulation R-values or U-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.~~
7. ~~Name and version of the compliance software tool. Where on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system. Additional documentation reporting estimated annual energy production shall be provided.~~
- 6-7.

**R405.3.3 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 R405.5.2(1).~~
3. ~~Documentation of the actual values used in the software calculations for the proposed design.~~

**R405.54 Calculation procedure.** Calculations of the performance design shall be in accordance with Sections R405.5.1 and R405.5.2.

**R405.54.1 General.** Except as specified by this section, the *standard reference design* and *proposed design* shall be configured and analyzed using identical methods and techniques.

**R405.54.2 Residence specifications.** The *standard reference design* and *proposed design* shall be

configured and analyzed as specified by Table R405.54.2(1). Table R405.54.2(1) shall include by reference all notes contained in Table ~~R402.1.1~~R402.1.3.

**TABLE R405.54.2(1)**  
**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.<br>Gross area: Same as proposed<br><i>U</i> -factor: From Table <a href="#">R402.1.3R402.1.2</a><br>Solar absorptance = 0.75<br>Emittance = 0.90                                                                                                                                                                                                                                                                                                                                                                                                                                                         | As proposed<br><br>As proposed<br>As proposed<br>As proposed<br>As proposed                                  |
| Below-grade walls                                          | Type: Same as proposed<br>Gross area: Same as proposed<br><i>U</i> -factor: From Table <a href="#">R402.1.3R402.1.2</a> , with insulation layer on interior side of walls.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | As proposed<br>As proposed<br>As proposed                                                                    |
| Above-grade floors                                         | Type: Wood frame<br>Gross area: Same as proposed<br><i>U</i> -factor: From Table <a href="#">R402.1.3R402.1.2</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | As proposed<br>As proposed<br>As proposed                                                                    |
| Ceilings                                                   | Type: Wood frame<br>Gross area: Same as proposed<br><i>U</i> -factor: From Table <a href="#">R402.1.3R402.1.2</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | As proposed<br>As proposed<br>As proposed                                                                    |
| Roofs                                                      | Type: Composition shingle on wood sheathing<br>Gross area: Same as proposed<br>Solar absorptance = 0.75<br>Emittance = 0.90                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | As proposed<br>As proposed<br>As proposed<br>As proposed                                                     |
| Attics                                                     | Type: Vented with aperture = 1 ft <sup>2</sup> per 300 ft <sup>2</sup> ceiling area                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | As proposed                                                                                                  |
| Foundations                                                | Type: Same as proposed foundation wall area above and below-grade<br>Soil characteristics: Same as proposed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | As proposed<br><br>As proposed                                                                               |
| Opaque Doors                                               | Area: 40 ft <sup>2</sup><br>Orientation: North<br><i>U</i> -factor: Same as fenestration from Table <a href="#">R402.1.3R402.1.2</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | As proposed<br>As proposed<br>As proposed                                                                    |
| Vertical fenestration other than opaque doors <sup>a</sup> | Total area <sup>h</sup> =<br>(a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area.<br>(b) 15% of the conditioned floor area; where the proposed glazing area is 15% or more of the conditioned floor area.<br>Orientation: Equally distributed to four cardinal compass orientations (N, E, S & W).<br><i>U</i> -factor: From Table <a href="#">R402.1.3R402.1.2</a><br>SHGC: From Table <a href="#">R402.1.4R402.1.3</a> except that for climates with no requirement (NR) SHGC = 0.40 shall be used.<br>Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design)<br>External shading: None | As proposed<br><br><br>As proposed<br><br>As proposed<br><br>0.92 - (0.21 × SHGC as proposed)<br>As proposed |
| Skylights                                                  | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | As proposed                                                                                                  |

**TABLE R405.54.2(1) (continued)**  
**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

| BUILDING COMPONENT                          | STANDARD REFERENCE DESIGN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PROPOSED DESIGN                                                                                                                                                                     |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Air exchange rate                           | <p>Air leakage rate of 5.0 air changes per hour at a pressure of 0.2 inches w.g. (50 Pa).</p> <p>The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than <math>0.01 \times CFA + 7.5 \times (N_{br} + 1)</math> where:</p> <p><math>CFA</math> = conditioned floor area<br/> <math>N_{br}</math> = number of bedrooms</p> <p><u>The mechanical ventilation system type shall be the same as in the proposed design.</u> Energy recovery shall not be assumed for mechanical ventilation.</p> | <p>As proposed<sup>a</sup>.</p> <p>The mechanical ventilation rate<sup>b</sup> shall be in addition to the air leakage rate and shall be as proposed.</p>                           |
| Mechanical ventilation                      | <p>None, except where mechanical ventilation is specified by the proposed design, in which case:</p> <p>Annual vent fan energy use:<br/> <math>kWh/yr = (1e_f) \times (0.0876 \times CFA + 65.7 \times (N_{br} + 1))</math></p> <p>where:</p> <p><math>e_f</math> = the minimum <b>exhaust</b> fan efficacy from Table R403.6.1 corresponding <u>to the system type at</u> to a flow rate of <math>0.01 \times CFA + 7.5 \times (N_{br} + 1)</math></p> <p><math>CFA</math> = conditioned floor area<br/> <math>N_{br}</math> = number of bedrooms</p>                        | As proposed                                                                                                                                                                         |
| Internal gains                              | $I_{Gain} = 17,900 + 23.8 \times CFA + 4104 \times N_{br}$ (Btu/day per dwelling unit)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Same as standard reference design                                                                                                                                                   |
| Internal mass                               | An internal mass for furniture and contents of 8 pounds per square foot of floor area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Same as standard reference design, plus any additional mass specifically designed as a thermal storage element <sup>c</sup> but not integral to the building envelope or structure. |
| Structural mass                             | <p>For masonry floor slabs, 80% of floor area covered by R-2 carpet and pad, and 20% of floor directly exposed to room air.</p> <p>For masonry basement walls, as proposed, but with insulation required by Table <del>R402.1.3</del><u>R402.1.2</u> located on the interior side of the walls.</p> <p>For other walls, for ceilings, floors, and interior walls, wood frame construction.</p>                                                                                                                                                                                | <p>As proposed</p> <p>As proposed</p> <p>As proposed</p>                                                                                                                            |
| Heating systems <sup>d, e</sup>             | <p>Where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the WSEC—Commercial Provisions. For all other systems, the same system type as proposed, and the same system efficiency required by prevailing minimum federal standard.</p> <p>Capacity: Sized in accordance with Section R403.6</p>                                                                                                                                                   | As proposed                                                                                                                                                                         |
| Cooling systems <sup>d, f</sup>             | <p>Same system type as proposed. Same system efficiency as required by prevailing minimum federal standard.</p> <p>Capacity: Sized in accordance with Section R403.6.</p>                                                                                                                                                                                                                                                                                                                                                                                                     | As proposed                                                                                                                                                                         |
| Service water heating <sup>d, e, f, g</sup> | <p><del>Same system type as proposed. Same system efficiency as required by prevailing minimum federal standard.</del></p> <p><del>Use: Same as proposed design</del></p>                                                                                                                                                                                                                                                                                                                                                                                                     | <p>As proposed</p> <p><math>gal/day = 30 + (10 \times N_{br})</math></p>                                                                                                            |

|                                             | <p><u>Same system type as proposed. Same system efficiency as required by prevailing minimum federal standard.</u></p> <p><u>Use, in units of gal/day – 30 + (10xN<sub>br</sub>) Where N<sub>br</sub> = number of bedrooms</u></p>                                                                                                                                                                                                | <p><u>As proposed</u><br/> <u>Use, in units of gal/day = 25.5 + (8.5 x N<sub>br</sub>) x (1- HWDS)</u><br/> <u>Where:</u><br/> <u>N<sub>br</sub> = number of bedrooms</u><br/> <u>HWDS = factor for the compactness of the hot water distribution system.</u></p> <table border="1"> <thead> <tr> <th colspan="2"><u>Compactness ratio<sup>1</sup> factor</u></th> <th><u>HWDS</u></th> </tr> </thead> <tbody> <tr> <td><u>1 story</u></td> <td><u>2 or more stories</u></td> <td></td> </tr> <tr> <td><u>&gt;60%</u></td> <td><u>&gt;30%</u></td> <td><u>0</u></td> </tr> <tr> <td><u>&gt;30% to ≤60%</u></td> <td><u>&gt;15% to ≤30%</u></td> <td><u>0.05</u></td> </tr> <tr> <td><u>&gt;15% to ≤30%</u></td> <td><u>&gt;7.5% to ≤15%</u></td> <td><u>0.10</u></td> </tr> <tr> <td><u>&lt;15%</u></td> <td><u>&lt;7.5%</u></td> <td><u>0.15</u></td> </tr> </tbody> </table> | <u>Compactness ratio<sup>1</sup> factor</u> |  | <u>HWDS</u> | <u>1 story</u> | <u>2 or more stories</u> |  | <u>&gt;60%</u> | <u>&gt;30%</u> | <u>0</u> | <u>&gt;30% to ≤60%</u> | <u>&gt;15% to ≤30%</u> | <u>0.05</u> | <u>&gt;15% to ≤30%</u> | <u>&gt;7.5% to ≤15%</u> | <u>0.10</u> | <u>&lt;15%</u> | <u>&lt;7.5%</u> | <u>0.15</u> |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--|-------------|----------------|--------------------------|--|----------------|----------------|----------|------------------------|------------------------|-------------|------------------------|-------------------------|-------------|----------------|-----------------|-------------|
| <u>Compactness ratio<sup>1</sup> factor</u> |                                                                                                                                                                                                                                                                                                                                                                                                                                   | <u>HWDS</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |  |             |                |                          |  |                |                |          |                        |                        |             |                        |                         |             |                |                 |             |
| <u>1 story</u>                              | <u>2 or more stories</u>                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             |  |             |                |                          |  |                |                |          |                        |                        |             |                        |                         |             |                |                 |             |
| <u>&gt;60%</u>                              | <u>&gt;30%</u>                                                                                                                                                                                                                                                                                                                                                                                                                    | <u>0</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                             |  |             |                |                          |  |                |                |          |                        |                        |             |                        |                         |             |                |                 |             |
| <u>&gt;30% to ≤60%</u>                      | <u>&gt;15% to ≤30%</u>                                                                                                                                                                                                                                                                                                                                                                                                            | <u>0.05</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |  |             |                |                          |  |                |                |          |                        |                        |             |                        |                         |             |                |                 |             |
| <u>&gt;15% to ≤30%</u>                      | <u>&gt;7.5% to ≤15%</u>                                                                                                                                                                                                                                                                                                                                                                                                           | <u>0.10</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |  |             |                |                          |  |                |                |          |                        |                        |             |                        |                         |             |                |                 |             |
| <u>&lt;15%</u>                              | <u>&lt;7.5%</u>                                                                                                                                                                                                                                                                                                                                                                                                                   | <u>0.15</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |  |             |                |                          |  |                |                |          |                        |                        |             |                        |                         |             |                |                 |             |
| Thermal distribution systems                | <p>Duct insulation: From Section R403.3.3</p> <p>A thermal distribution system efficiency (DSE) of 0.93 shall be applied to both the heating and cooling system efficiencies for all systems.</p> <p><u>Duct location: same as proposed design</u></p> <p><b>Exception:</b> For non-ducted heating and cooling systems that do not have a fan, the standard reference design distribution system efficiency (DSE) shall be 1.</p> | As specified in Table R405.5.2(2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             |  |             |                |                          |  |                |                |          |                        |                        |             |                        |                         |             |                |                 |             |
| Thermostat                                  | Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F                                                                                                                                                                                                                                                                                                                                            | Same as standard reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |  |             |                |                          |  |                |                |          |                        |                        |             |                        |                         |             |                |                 |             |

For SI: 1 square foot = 0.93 m<sup>2</sup>, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 gallon (U.S.) = 3.785 L, °C = (°F-3)/1.8, 1 degree = 0.79 rad

- Where required by the *code official*, testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent, shall be used to determine the energy loads resulting from infiltration.
- 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.
- 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.
- 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.
- 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 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.
- 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.

- h For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine fenestration area:

$$AF = A_s \times FA \times F$$

Where:

- $AF$  = Total fenestration area.
- $A_s$  = Standard reference design total fenestration 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.

$L$  and  $CFA$  are in the same units.

- i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multifamily buildings with central water heating systems, circulation loops or electric heat traced pipes.

2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.

5. The basement or attic shall be counted as a story when it contains the water heater.

6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and HWDS factor.

**TABLE R405.54.2(2)  
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS<sup>a</sup>**

| DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION                         | DISTRIBUTION SYSTEM EFFICIENCY |
|-------------------------------------------------------------------------|--------------------------------|
| Distribution system components located in unconditioned space           | 0.88                           |
| Distribution systems entirely located in conditioned space <sup>b</sup> | 0.93                           |
| Zonal systems <sup>c</sup>                                              | 1.00                           |

For SI: 1 cubic foot per minute = 0.47 L/s, 1 square foot = 0.093m<sup>2</sup>, 1 pound per square inch = 6895 Pa, 1 inch water gauge = 1250 Pa.

- a. Values given by this table are for distribution systems, which must still meet all prescriptive requirements for duct and pipe system insulation and leakage.
- b. Entire system in conditioned space shall mean that no component of the distribution system, including the air-handler unit, is located outside of the conditioned space. All components must be located on the interior side of the thermal envelope (inside the insulation) and also inside of the air barrier. Refrigerant compressors and piping are allowed to be located outside.
- c. Zonal systems are systems where the heat source is located within each room. Systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer's air-handler enclosure. Hydronic systems do not qualify.

**R405.65 Calculation software tools.** Calculation software, where used, shall be in accordance with Sections R405.6.1 through R405.6.3.

**R405.65.1 Minimum capabilities.** Calculation procedures used to comply with this section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the *standard reference design* and the *proposed design* and shall include the following capabilities:

1. Calculation of whole-building (as a single *zone*) sizing for the heating and cooling equipment in the *standard reference design* residence in accordance with Section R403.6.
2. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
3. Printed *code official* inspection checklist listing each of the *proposed design* component characteristics from Table R405.5.2(1) determined by the analysis to provide compliance, along with their respective performance ratings (e.g., *R*-value, *U*-factor, SHGC, HSPF, AFUE, SEER, EF, etc.).

**R405.65.2 Specific approval.** Performance analysis tools meeting the applicable sections of Section R405 shall be permitted to be *approved*. Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The *code official* shall be permitted to approve tools for a specified application or limited scope.

**R405.65.3 Input values.** When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an approved source.

## SECTION R406 ADDITIONAL ENERGY EFFICIENCY REQUIREMENTS

**R406.1 Scope.** This section establishes additional energy efficiency requirements for all new construction covered by this code, including additions subject to Section R502 and change of occupancy or use subject to Section R505 unless specifically exempted in Section R406. Credit from both Sections R406.2 and R406.3 are required.

**R406.2 Carbon emission equalization.** This section establishes a base equalization between fuels used to define the equivalent carbon emissions of the options specified. The permit shall define the base fuel selection to be used and the points specified in Table R406.2 shall be used to modify the requirements in Section R406.3. The sum of credits from Tables R406.2 and R406.3 shall meet the requirements of Section R406.3.

**R406.3 Additional energy efficiency requirements.** Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 so as to achieve the following minimum number of credits:

1. Small Dwelling Unit: ..... 3.0 credits  
Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet of fenestration area. Additions to existing building greater than 500 square feet of heated floor area but less than 1500 square feet.
2. Medium Dwelling Unit: ..... 6.0 credits  
All dwelling units that are not included in #1, #3 or #4.
3. Large Dwelling Unit: ..... 7.0 credits  
Dwelling units exceeding 5000 square feet of conditioned floor area.
4. Dwelling units serving R-2 occupancies: ..... 4.5 credits
5. Additions less than or equal to 500 square feet:..... 1.5 credits

The drawings included with the building permit application shall identify which options have been selected and the point value of each option, regardless of whether separate mechanical, plumbing, electrical, or other permits are utilized for the project.



**TABLE R406.2  
FUEL NORMALIZATION CREDITS**

| System Type | Description of Primary Heating Source                                                                                                                                                                                                                                                         | Credits   |           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|             |                                                                                                                                                                                                                                                                                               | All Other | Group R-2 |
| 1           | Combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(4) or C403.3.2(5)                                                                                                                                                        | 0         | 0         |
| 2           | For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(1)C or C403.3.2(2)<br><b>or</b><br>Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590 | 1.0       | 1.0       |
| 3           | For heating system based on electric resistance only (either forced air or Zonal)                                                                                                                                                                                                             | -1.0      | -1.0      |
| 4           | For heating system based on electric resistance with a ductless mini-split heat pump system in accordance with Section R403.7.1 including the exception                                                                                                                                       | 0.5       | N/A       |
| 5           | All other heating systems                                                                                                                                                                                                                                                                     | -1        | -0.5      |

**TABLE R406.3  
ENERGY CREDITS**

| OPTION                                                                                                                                                                                                                               | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                        | CREDIT(S) |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                    | All Other | Group R-2 |
| <b>1. EFFICIENT BUILDING ENVELOPE OPTIONS</b>                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |           |
| Only one option from Items 1.1 through 1.7 may be selected in this category.                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |           |
| Compliance with the conductive UA targets is demonstrated using Section <a href="#">R402.1.4</a> <a href="#">R402.1.5</a> , Total UA alternative, where $[1 - (\text{Proposed UA} / \text{Target UA})] >$ the required %UA reduction |                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |           |
| 1.1                                                                                                                                                                                                                                  | Prescriptive compliance is based on Table <a href="#">R402.1.4</a> <a href="#">R402.1.3</a> with the following modifications:<br>Vertical fenestration U = 0.24.                                                                                                                                                                                                                                                                   | 0.5       | 0.5       |
| 1.2                                                                                                                                                                                                                                  | Prescriptive compliance is based on Table <a href="#">R402.1.4</a> <a href="#">R402.1.3</a> with the following modifications:<br>Vertical fenestration U = 0.20.                                                                                                                                                                                                                                                                   | 1.0       | 1.0       |
| 1.3                                                                                                                                                                                                                                  | Prescriptive compliance is based on Table <a href="#">R402.1.4</a> <a href="#">R402.1.3</a> with the following modifications:<br>Vertical fenestration U = 0.28<br>Floor R-38<br>Slab on grade R-10 perimeter and under entire slab<br>Below grade slab R-10 perimeter and under entire slab<br><b>or</b><br>Compliance based on Section <a href="#">R402.1.4</a> <a href="#">R402.1.5</a> : Reduce the Total conductive UA by 5%. | 0.5       | N/A       |
| 1.4                                                                                                                                                                                                                                  | Prescriptive compliance is based on Table <a href="#">R402.1.4</a> <a href="#">R402.1.3</a> with the following modifications:<br>Vertical fenestration U = 0.25<br>Wall R-21 plus R-4 ci<br>Floor R-38                                                                                                                                                                                                                             | 1.0       | 1.0       |

| OPTION                                                                                                                                          | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CREDIT(S) |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | All Other | Group R-2 |
|                                                                                                                                                 | Basement wall R-21 int plus R-5 ci<br>Slab on grade R-10 perimeter and under entire slab<br>Below grade slab R-10 perimeter and under entire slab<br><b>or</b><br>Compliance based on Section <del>R402.1.4</del> R402.1.5: Reduce the Total conductive UA by 15%.                                                                                                                                                                                                                                                                   |           |           |
| 1.5                                                                                                                                             | Prescriptive compliance is based on Table <del>R402.1.4</del> R402.1.3 with the following modifications:<br>Vertical fenestration U = 0.22<br>Ceiling and single-rafter or joist-vaulted R-49 advanced<br>Wood frame wall R-21 int plus R-12 ci<br>Floor R-38<br>Basement wall R-21 int plus R-12 ci<br>Slab on grade R-10 perimeter and under entire slab<br>Below grade slab R-10 perimeter and under entire slab<br><b>or</b><br>Compliance based on Section <del>R402.1.4</del> R402.1.5: Reduce the Total conductive UA by 30%. | 2.0       | 1.5       |
| 1.6                                                                                                                                             | Prescriptive compliance is based on Table <del>R402.1.4</del> R402.1.3 with the following modifications:<br>Vertical fenestration U = 0.18<br>Ceiling and single-rafter or joist-vaulted R-60 advanced<br>Wood frame wall R-21 int plus R-16 ci<br>Floor R-48<br>Basement wall R-21 int plus R-16 ci<br>Slab on grade R-20 perimeter and under entire slab<br>Below grade slab R-20 perimeter and under entire slab<br><b>or</b><br>Compliance based on Section <del>R402.1.4</del> R402.1.5: Reduce the Total conductive UA by 40%. | 3.0       | 2.0       |
| 1.7                                                                                                                                             | Advanced framing and raised heel trusses or rafters<br>Vertical Glazing U-0.28<br>R-49 Advanced (U-0.020) as listed in Section A102.2.1, <i>Ceilings below a vented attic</i><br><b>and</b><br>R-49 vaulted ceilings with full height of uncompressed insulation extending over the wall top plate at the eaves.                                                                                                                                                                                                                     | 0.5       | 0.5       |
| <b>2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS</b><br>Only one option from Items 2.1 through 2.4 may be selected in this category. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |           |
| 2.1                                                                                                                                             | Compliance based on Section R402.4.1.2:<br>Reduce the tested air leakage to 3.0 air changes per hour maximum at 50 Pascals<br><b>or</b><br>For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.3 cfm/ft <sup>2</sup> maximum at 50 Pascals<br><b>and</b><br>All whole house ventilation requirements as determined by Section M1505.3 of the <i>International Residential Code</i> or Section 403.8 of the                                                                      | 0.5       | 1.0       |

| OPTION | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CREDIT(S) |           |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | All Other | Group R-2 |
|        | <p><i>International Mechanical Code</i> shall be met with a high efficiency fan(s) (maximum 0.35 watts/cfm), not interlocked with the furnace fan (if present). Ventilation systems using a furnace including an ECM motor are allowed, provided that they are controlled to operate at low speed in ventilation only mode.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected, the maximum tested building air leakage, and shall show the qualifying ventilation system and its control sequence of operation.</p>                                                                                                                                                                                                                                                                                        |           |           |
| 2.2    | <p>Compliance based on Section R402.4.1.2:<br/>Reduce the tested air leakage to 2.0 air changes per hour maximum at 50 Pascals</p> <p><b>or</b></p> <p>For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.25 cfm/ft<sup>2</sup> maximum at 50 Pascals</p> <p><b>and</b></p> <p>All whole house ventilation requirements as determined by Section M1507.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.65.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.</p> | 1.0       | 1.5       |
| 2.3    | <p>Compliance based on Section R402.4.1.2:<br/>Reduce the tested air leakage to 1.5 air changes per hour maximum at 50 Pascals</p> <p><b>or</b></p> <p>For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.20 cfm/ft<sup>2</sup> maximum at 50 Pascals</p> <p><b>and</b></p> <p>All whole house ventilation requirements as determined by Section M1507.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.75.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.</p> | 1.5       | 2.0       |
| 2.4    | <p>Compliance based on Section R402.4.1.2:<br/>Reduce the tested air leakage to 0.6 air changes per hour maximum at 50 Pascals</p> <p><b>or</b></p> <p>For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.15 cfm/ft<sup>2</sup> maximum at 50 Pascals</p> <p><b>and</b></p> <p>All whole house ventilation requirements as determined by Section M1507.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of</p>                                                                                                                                                                                                                                   | 2.0       | 2.5       |

| OPTION                                                                                                                                      | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CREDIT(S) |           |
|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | All Other | Group R-2 |
|                                                                                                                                             | <p>0.80. Duct installation shall comply with Section R403.3.7.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.</p>                                                                                                                                                                                                                                                      |           |           |
| <p><b>3. HIGH EFFICIENCY HVAC EQUIPMENT OPTIONS</b></p> <p>Only one option from Items 3.1 through 3.6 may be selected in this category.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |           |
| 3.1 <sup>a</sup>                                                                                                                            | <p>Energy Star rated (U.S. North) Gas or propane furnace with minimum AFUE of 95%</p> <p><b>or</b></p> <p>Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>                                                                                                                                                        | 1.0       | 1.0       |
| 3.2 <sup>a</sup>                                                                                                                            | <p>Air-source centrally ducted heat pump with minimum HSPF of 9.5.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>                                                                                                                                                                                                                                                                              | 1.0       | N/A       |
| 3.3 <sup>a</sup>                                                                                                                            | <p>Closed-loop ground source heat pump; with a minimum COP of 3.3</p> <p><b>or</b></p> <p>Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>                                                                                                                                            | 1.5       | 1.0       |
| 3.4                                                                                                                                         | <p>Ductless mini-split heat pump system, zonal control: In homes where the primary space heating system is zonal electric heating, a ductless mini-split heat pump system with a minimum HSPF of 10.0 shall be installed and provide heating to the largest zone of the housing unit.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>                                                           | 1.5       | 2.0       |
| 3.5 <sup>a</sup>                                                                                                                            | <p>Air-source, centrally ducted heat pump with minimum HSPF of 11.0.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>                                                                                                                                                                                                                                                                            | 1.5       | N/A       |
| 3.6 <sup>a</sup>                                                                                                                            | <p>Ductless split system heat pumps with no electric resistance heating in the primary living areas. A ductless heat pump system with a minimum HSPF of 10 shall be sized and installed to provide heat to entire dwelling unit at the design outdoor air temperature.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected, the heated floor area calculation, the heating equipment type(s), the minimum equipment efficiency, and total installed heat capacity (by equipment type).</p> | 2.0       | 3.0       |

**TABLE R406.3 (continued)  
ENERGY CREDITS**

| OPTION                                                                                                                 | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CREDIT(S) |           |
|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | All Other | Group R-2 |
| <b>4. HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM OPTIONS</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |           |
| 4.1                                                                                                                    | <p>All supply and return ducts located in an unconditioned attic shall be deeply buried in ceiling insulation in accordance with Section R403.3.6.</p> <p>For mechanical equipment located outside the conditioned space, a maximum of 10 linear feet of return duct and 5 linear feet of supply duct connections to the equipment may be outside the deeply buried insulation. All metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic. If flex ducts are used, they cannot contain splices.</p> <p>Duct leakage shall be limited to 3 cfm per 100 square feet of conditioned floor area.</p> <p>Air handler(s) shall be located within the conditioned space.</p> | 0.5       | 0.5       |
| 4.2                                                                                                                    | <p>HVAC equipment and associated duct system(s) installation shall comply with the requirements of Section R403.3.7.</p> <p>Locating system components in conditioned crawl spaces is not permitted under this option.</p> <p>Electric resistance heat and ductless heat pumps are not permitted under this option.</p> <p>Direct combustion heating equipment with AFUE less than 80% is not permitted under this option.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and shall show the location of the heating and cooling equipment and all the ductwork.</p>                                                           | 1.0       | N/A       |
| <b>5. EFFICIENT WATER HEATING OPTIONS</b>                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |           |
| Only one option from Items 5.2 through 5.6 may be selected in this category. Item 5.1 may be combined with any option. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |           |
| 5.1                                                                                                                    | <p>A drain water heat recovery unit(s) shall be installed, which captures waste water heat from all and only the showers, and has a minimum efficiency of 40% if installed for equal flow or a minimum efficiency of 54% if installed for unequal flow. Such units shall be rated in accordance with CSA B55.1 or IAPMO IGC 346-2017 and be so labeled.</p> <p>To qualify to claim this credit, the building permit drawings shall include a plumbing diagram that specifies the drain water heat recovery units and the plumbing layout needed to install it. Labels or other documentation shall be provided that demonstrates that the unit complies with the standard.</p>                                                            | 0.5       | 0.5       |
| 5.2                                                                                                                    | <p>Water heating system shall include one of the following:</p> <p>Energy Star rated gas or propane water heater with a minimum UEF of 0.80.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.</p>                                                                                                                                                                                                                                                                                                                                                                                     | 0.5       | 0.5       |

**TABLE R406.3 (continued)  
ENERGY CREDITS**

| OPTION | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CREDIT(S) |           |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | All Other | Group R-2 |
| 5.3    | <p>Water heating system shall include one of the following:<br/>Energy Star rated gas or propane water heater with a minimum UEF of 0.91</p> <p><b>or</b></p> <p>Solar water heating supplementing a minimum standard water heater. Solar water heating will provide a rated minimum savings of 85 therms or 2000 kWh based on the Solar Rating and Certification Corporation (SRCC) Annual Performance of OG-300 Certified Solar Water Heating Systems</p> <p><b>or</b></p> <p>Water heater heated by ground source heat pump meeting the requirements of Option 3.3.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.</p> | 1.0       | 1.0       |
| 5.4    | <p>Water heating system shall include one of the following:<br/>Electric heat pump water heater meeting the standards for Tier I of NEEA's advanced water heating specification</p> <p><b>or</b></p> <p>For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier I of NEEA's advanced water heating specification, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.</p>                                                                                               | 1.5       | 2.0       |
| 5.5    | <p>Water heating system shall include one of the following:<br/>Electric heat pump water heater meeting the standards for Tier III of NEEA's advanced water heating specification</p> <p><b>or</b></p> <p>For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.</p>                                                                                           | 2.0       | 2.5       |

**TABLE R406.3 (continued)  
ENERGY CREDITS**

| OPTION                                     | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CREDIT(S) |           |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | All Other | Group R-2 |
| 5.6                                        | <p>Water heating system shall include one of the following:</p> <p>Electric heat pump water heater with a minimum UEF of 2.9 and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors. Equipment shall meet Section 4, requirements for all units, of the NEEA standard <i>Advanced Water Heating Specification</i> with the UEF noted above</p> <p><b>or</b></p> <p>For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.</p> | 2.5       | 3.0       |
| <b>6. RENEWABLE ELECTRIC ENERGY OPTION</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |           |
| 6.1                                        | <p>For each 1200 kWh of electrical generation per housing unit provided annually by on-site wind or solar equipment a 1.0 credit shall be allowed, up to 3 credits. Generation shall be calculated as follows:</p> <p>For solar electric systems, the design shall be demonstrated to meet this requirement using the National Renewable Energy Laboratory calculator PVWATTs or approved alternate by the code official.</p> <p>Documentation noting solar access shall be included on the plans.</p> <p>For wind generation projects designs shall document annual power generation based on the following factors:</p> <p>The wind turbine power curve; average annual wind speed at the site; frequency distribution of the wind speed at the site and height of the tower.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the photovoltaic or wind turbine equipment type, provide documentation of solar and wind access, and include a calculation of the minimum annual energy power production.</p> | 1.0       | 1.0       |
| <b>7. APPLIANCE PACKAGE OPTION</b>         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |           |
| 7.1                                        | <p>All of the following appliances shall be new and installed in the dwelling unit and shall meet the following standards:</p> <p>Dishwasher – Energy Star rated</p> <p>Refrigerator (if provided) – Energy Star rated</p> <p>Washing machine – Energy Star rated</p> <p>Dryer – Energy Star rated, ventless dryer with a minimum CEF rating of 5.2.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the appliance type and provide documentation of Energy Star compliance. At the time of inspection, all appliances shall be installed and connected to utilities. Dryer ducts and exterior dryer vent caps are not permitted to be installed in the dwelling unit.</p>                                                                                                                                                                                                                                                                                                                                    | 0.5       | 1.5       |



- a. An alternative heating source sized at a maximum of 0.5 Watts/ft<sup>2</sup> (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.

## **SECTION R407 CERTIFIED PASSIVE HOUSE**

**R407.1 General.** Projects shall comply with Section R407.2 or R407.3.

**R407.2 Passive House Institute U.S. (PHIUS).** Projects shall comply with PHIUS+ 2018 Passive Building Standard, including its USDOE Energy Star and Zero Energy Ready Home co-requisites, and performance calculations by PHIUS-approved software. Projects shall also comply with the provisions of Table R405.2.

**R407.2.1 PHIUS documentation.** Prior to the issuance of a building permit, the following items must be provided to the *code official*:

1. A list of compliance features.
2. A PHIUS precertification letter.

Prior to the issuance of a certificate of occupancy, the following item must be provided to the *code official*:

1. A PHIUS+ 2018 (or later) project certificate.

**R407.3 Passive House Institute (PHI).** Projects shall comply with Low Energy Building Standard, version 9f or later, including performance calculations by PHI-approved software. Projects shall also comply with the provisions of Section R401 through R404.

**R407.3.1 PHI documentation.** Prior to the issuance of a building permit, the following items must be provided to the *code official*:

1. A list of compliance features.
2. A statement from a passive house certifier that the modeled energy performance is congruent with the plans and specifications, and that the modeled performance meets said standard.

Prior to the issuance of a certificate of occupancy, the following item must be provided to the *code official*:

1. A PHI Low Energy Building project certificate.

## CHAPTER 5

# EXISTING BUILDINGS

### SECTION R501 GENERAL

**R501.1 Scope.** The provisions of this chapter shall control the *alteration, repair, addition* and change of occupancy of existing buildings and structures.

~~R501.2~~**R501.1.1 Existing buildings General.** 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. Unaltered portions of the existing building or building supply system shall not be required to comply with this code.

**R501.1.2 Thermostats for accessory dwelling units.** Where a separate dwelling unit, that provides independent facilities for living, sleeping, cooking, bathing and sanitation, is established within or attached to an existing dwelling unit, the heating and cooling for the newly-created dwelling unit shall be controllable with a separate programmable thermostat in accordance with Section R403.1.1.

~~R501.1.1~~**R501.2 Additions, alterations, or repairs Compliance.** Additions, alterations, ~~or repairs or changes of occupancy to, or relocation of,~~ an existing building, building system or portion thereof shall comply with Sections R502, R503, ~~or R504 or R505, respectively, in this code.~~ Unaltered portions of the existing building or building supply system shall not be required to comply with this code. Changes where unconditioned space is changed to conditioned space shall comply with Section R502.

**R501.3 Maintenance.** 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 with 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.** *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 this code and the *International Residential Code, International Building Code, International Existing Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, Uniform Plumbing Code, International Property Maintenance Code*, and NFPA 70.

**R501.5 New and replacement materials.** 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.** The *code official* may modify the specific requirements of this code for historic buildings and require alternate provisions which will result in a reasonable degree of energy efficiency. This modification may be allowed for those buildings or structures that are listed in the state or national register of historic places; designated as a historic property under local or state designation law or survey; certified as a contributing resource with a national register listed or locally designated historic district; or with an opinion or certification that the property is eligible to be listed on the national or state registers of historic places either individually or as a contributing building to a historic district by the state historic preservation officer or the keeper of the national register of historic places.

## SECTION R502 ADDITIONS

**R502.1 General.** 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.

**R502.2 Change in space conditioning.** 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 use of the proposed design is permitted to be 110 percent of the annual energy use otherwise allowed by Section R405.3.

2. Where the Total UA, as determined in Section R402.1.5, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to the Total UA generated for the existing building.

3. Where complying in accordance with Section R405 and the annual 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 use of the existing building. The addition and any alterations that are part of the project shall comply with Section R405 in its entirety.

**R502.1.1R502.3 Prescriptive compliance.** Additions shall comply with Sections R502.1.1.1 through R502.1.1.4.

**R502.1.1.1R502.3.1 Building envelope.** 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 ~~R402.1.4~~R402.1.5, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to the UA generated for the existing building.

**R502.1.1.2R502.3.2 Heating and cooling systems.** ~~New heating, cooling and duct systems that are part of the~~HVAC ducts newly installed as part of an addition shall comply with Section R403.

**Exception:** The following need not comply with the testing requirements of Section R403.3.3:

1. Additions of less than 750 square feet.
2. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in WSU RS-33.
3. ~~Ducts with less than 40 linear feet in unconditioned spaces.~~
4. Existing duct systems constructed, insulated or sealed with asbestos.

**R502.1.1.3R502.3.3 Service hot water systems.** New service hot water systems that are part of the addition shall comply with Section R403.5.

**R502.1.1.4R502.3.4 Lighting.** New lighting systems that are part of the addition shall comply with Section 404.1.

**R502.1.2 Existing plus addition compliance (Simulated Performance Alternative).** Where nonconditioned space is changed to conditioned space the addition shall comply where the annual 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 use 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.** Alterations to any building or structure shall comply with the requirements of the code for new construction, without requiring the unaltered portions of the existing building or building system to comply with this code. 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 Section R503.1.1 through R503.2.

The code official may approve designs of alterations which do not fully conform to all of the requirements of this code where in the opinion of the *code official* full compliance is physically impossible and/or economically impractical and:

1. The alteration improves the energy efficiency of the building; or
2. The alteration is energy efficient and is necessary for the health, safety, and welfare of the general public.

**R503.1.1 Building envelope.** Building envelope assemblies that are part of the alteration shall comply with Section ~~R402.1.4~~R402.1.3 or ~~R402.1.4~~R402.1.5, Sections R402.2.1 through R402.2.10, 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. 2x4 framed walls shall be insulated to a minimum of R-15 and 2x6 framed walls shall be insulated to a minimum of R-21.
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 fenestration to be replaced.

**R503.1.1.1 Replacement fenestration.** 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 in Table ~~R402.1.4~~R402.1.3. Where more than one replacement fenestration unit is being installed, an area-weighted average of the *U*-factor and SHGC of all replacement fenestration shall be permitted to be used to demonstrate compliance.

**R503.1.2 Heating and cooling systems.** New heating, cooling and duct systems that are part of the alteration shall comply with Section R403.

**Exceptions:**

1. Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet in unconditioned spaces shall not be required to be tested in accordance with Section R403.2.2.
2. Existing duct systems constructed, insulated or sealed with asbestos.

**R503.1.3 Service hot water systems.** New service hot water systems that are part of the alteration shall comply with Section R403.5.

**R503.1.4 Lighting.** New lighting systems that are part of the alteration shall comply with Section R404.1.

**Exception:** Alterations that replace less than 50-10 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.** 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 use of the proposed design is permitted to be 110 percent of the annual energy use otherwise allowed by Section R405.3.~~

## SECTION R504 REPAIRS

**R504.1 General.** Buildings, structures and parts thereof shall be repaired in compliance with Section R501.3 and this section. Work on nondamaged components that is 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.

The code official may approve designs of repairs which do not fully conform with all of the requirements of this code where in the opinion of the *code official* full compliance is physically impossible and/or economically impractical and:

1. The repair improves the energy efficiency of the building; or
2. The repair is energy efficient and is necessary for the health, safety, and welfare of the general public.

**R504.2 Application.** 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 ~~Change in occupancy or use~~General.** Any space not within the scope of Section R101.2 which is converted to space that is within the scope of Section R101.2 shall be brought into full compliance with this code.

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.

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 use of the proposed design is permitted to be 110 percent of the annual energy use otherwise allowed by Section R405.3.

**R505.1.1 Unconditioned space.** Any unconditioned or low-energy space that is altered to become a conditioned space shall comply with Section R502.

## CHAPTER 6

### REFERENCED STANDARDS

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 R106.

## AAMA

American Architectural Manufacturers Association  
1827 Walden Office Square  
Suite 550  
Schaumburg, IL 60173-4268

| Standard reference number         | Title                                                                                            | Referenced in code section number |
|-----------------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------|
| AAMA/WDMA/CSA 101/I.S.2/A C440—17 | North American Fenestration Standard/ Specifications for Windows, Doors and Unit Skylights ..... | R402.4.3                          |

## ACCA

Air Conditioning Contractors of America  
2800 Shirlington Road, Suite 300  
Arlington, VA 22206

| Standard reference number | Title                                             | Referenced in code section number |
|---------------------------|---------------------------------------------------|-----------------------------------|
| Manual J—16               | Residential Load Calculation Eighth Edition ..... | R403.6                            |
| Manual S—14               | Residential Equipment.....                        | R403.6                            |

## ANSI

America National Standards Institute  
25 West 43<sup>rd</sup> Street, 4<sup>th</sup> Floor  
New York, NY 10036

| Standard reference number | Title                                  | Referenced in code section number |
|---------------------------|----------------------------------------|-----------------------------------|
| Z21-50-2016/CSA 2.22-16   | Vented Decorative Gas Appliances ..... | R402.4.2.1, R403.1.3              |
| Z21.88-2017/CSA 2.23-17   | Vented Gas Fireplace Heaters.....      | R402.4.2.1                        |

## APSP

The Association of Pool and Spa Professionals  
2111 Eisenhower Avenue  
Alexandria, VA 22314

| Standard reference number | Title                                                                                    | Referenced in code section number |
|---------------------------|------------------------------------------------------------------------------------------|-----------------------------------|
| APSP 14-14                | American National Standard for Portable Electric Spa Energy Efficiency .....             | R403.11                           |
| APSP 15a-2013             | American National Standard for Residential Swimming Pool and Spa energy efficiency ..... | R403.12                           |



# ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.  
1791 Tullie Circle, NE  
Atlanta, GA 30329-2305

| Standard reference number | Title                                                                   | Referenced in code section number                                     |
|---------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------|
| ASHRAE—2017               | ASHRAE Handbook of Fundamentals .....                                   | <a href="#">R402.1.4</a> <a href="#">R402.1.5</a> , Table R405.5.2(1) |
| ASHRAE 193—2010 (RA 2014) | Method of Test for Determining the Airtightness of HVAC Equipment ..... | R403.2.2.1                                                            |

# 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— <a href="#">2004</a> (2012)                                                 | 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<br><a href="#">E1554/E1554M—E2013</a>                                     | Standard Test Method for Determining Air Leakage Rate by Fan Pressurization<br><a href="#">Standard Test Methods for Determining Air Leakage of Air Distribution Systems by Fan Pressurization.....</a> | R402.4.1.2<br><a href="#">R403.3.5</a>                                                           |
| E1827- <a href="#">2011</a> ( <a href="#">2017</a> )<br><a href="#">E2178—2013</a> | Standard Test Method for Determining Airtightness of Building Using an Orifice Blower Door .....                                                                                                        | R402.4.1.2<br><a href="#">Standard Test Method for Air Permeance of Building Materials .....</a> |

# CSA

Canadian Standards Association  
5060 Spectrum Way  
Mississauga, Ontario, Canada L4W 5N6

| Standard reference number       | Title                                                                                             | Referenced in code section number |
|---------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------|
| AAMA/WDMA/CSA 101/I.S.2/A440—17 | North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights .....    | R402.4.3                          |
| CSA 55.1-2015                   | Test Method for Measuring Efficiency and Pressure Loss of Drain Water Heat Recovery Systems ..... | R403.5.4, Table R406.2            |
| CSA 55.2-2015                   | Drain Water Heat Recovery Units .....                                                             | R403.5.4                          |
| CSA P.4.1-15                    | Testing Method for Measuring Annual Fireplace Efficiency .....                                    | R403.5.4                          |

# DASMA

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

| Standard reference number | Title                                                                            | Referenced in code section number |
|---------------------------|----------------------------------------------------------------------------------|-----------------------------------|
| 105-2016                  | Test Method for Thermal Transmittance and Air Infiltration of Garage Doors ..... | R303.1.3                          |

# HVI

Home Ventilating Institute  
1000 North Rand Road, Suite 214  
Wauconda, IL 60084

| Standard reference number | Title                        | Referenced in code section number |
|---------------------------|------------------------------|-----------------------------------|
| 916-09                    | Airflow Test Procedure ..... | 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           |
|----------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------|
| <a href="#">ANSI/APSP/ICC 14—2019</a>  | <a href="#">American National Standard for Portable Electric Spa Energy Efficiency .....</a>             | <a href="#">R403.11</a>                     |
| <a href="#">ANSI/APSP/ICC 15a—2019</a> | <a href="#">American National Standard for Residential Swimming Pool and Spa Energy Efficiency .....</a> | <a href="#">R403.12</a>                     |
| <del>IBC—1821</del>                    | International Building Code .....                                                                        | R201.3, R303.2, R402.2.10                   |
| ICC 400—17                             | Standard on the Design and Construction of Log Structures .....                                          | Table R402.4.1.1                            |
| <a href="#">ICC 500—2020</a>           | <a href="#">ICC/NSSA Standard for the Design and Construction of Storm Shelters .....</a>                | <a href="#">R402.5</a>                      |
| <del>IFC—1821</del>                    | International Fire Code .....                                                                            | R201.3                                      |
| <del>IFGC—1821</del>                   | International Fuel Gas Code.....                                                                         | R201.3                                      |
| <del>IMC—1821</del>                    | International Mechanical Code.....                                                                       | R201.3, R403.2.2, R403.5                    |
| <del>IRC—1821</del>                    | International Residential Code .....                                                                     | R201.3, R303.2, R402.2.10, R403.2.2, R403.5 |

# NEEA

Northwest Energy Efficiency Alliance  
421 SW 6<sup>th</sup> Ave, Suite 600  
Portland, OR 97204

| Standard reference number | Title                                                                       | Referenced in code section number |
|---------------------------|-----------------------------------------------------------------------------|-----------------------------------|
| NEEA-2011                 | Northern Climate Specification for Heat Pump Water Heaters, Vers. 4.0 ..... | Table R406.2                      |

# NEMA

[National Electrical Manufacturers Association](#)  
[1300 17<sup>th</sup> Street N No. 900](#)  
[Arlington, VA 22209](#)

| <a href="#">Standard reference number</a> | <a href="#">Title</a>                                                                                  | <a href="#">Referenced in code section number</a> |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| <a href="#">OS 4—2016</a>                 | <a href="#">Requirements for Air-Sealed Boxes for Electrical and Communications Applications .....</a> | <a href="#">R402.4.6</a>                          |

# NFPA

[National Fire Protection Association](#)  
[1 Batterymarch Park](#)  
[Quincy, MA 02169-7417](#)

| <a href="#">Standard reference number</a> | <a href="#">Title</a>                          | <a href="#">Referenced in code section number</a> |
|-------------------------------------------|------------------------------------------------|---------------------------------------------------|
| <a href="#">70—20</a>                     | <a href="#">National Electrical Code .....</a> | <a href="#">R501.4</a>                            |

# NFRC

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

| Standard reference number | Title                                                                       | Referenced in code section number |
|---------------------------|-----------------------------------------------------------------------------|-----------------------------------|
| 100— <del>2010</del> 2020 | Procedure for Determining Fenestration Products U-factors—Second Edition .. | R303.1.3                          |
| 200— <del>2010</del> 2020 | Procedure for Determining Fenestration Product Solar Heat Gain Coefficients |                                   |

400—~~2010~~2020 and Visible Transmittance at Normal Incidence—Second Edition ..... R303.1.3  
 Procedure for Determining Fenestration Product Air Leakage—Second Edition R402.4.3

## UL

Underwriters Laboratories LLC  
 333 Pfingsten Road  
 Northbrook, IL 60062

| Standard reference number | Title                                                                              | Referenced in code section number |
|---------------------------|------------------------------------------------------------------------------------|-----------------------------------|
| 515--2015                 | Standard for Electrical Resistance Trace Heating for Commercial Applications ..... | 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  
 1400 East Touhy Avenue, Suite 470  
 Des Plaines, IL 60018

| 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                          |

## WSU

Washington State University Energy Extension Program  
 905 Plum Street SE, Bldg 3  
 PO Box 43165  
 Olympia, WA 98506-3166

| Standard reference number | Title                                                                                     | Referenced in code section number |
|---------------------------|-------------------------------------------------------------------------------------------|-----------------------------------|
| WSU RS 33                 | Duct Testing Standard for New and Existing Construction Publication No. WSUEEP12-016..... | R403.2.2                          |

## APPENDIX RA / RB

### OPTIONAL ENERGY EFFICIENCY MEASURES

**Appendix RA—Optional energy efficiency measures—One step.** Building owners may choose to use this appendix to achieve an additional 6 percent savings in building energy use. The number of additional energy efficiency credits required by Section R406.3 would be increased by the following amounts:

1.0 credit for each new single-family, two-family and townhouse dwelling unit.

0.5 credit for each new dwelling unit within an R-2 occupancy building.

0.5 credit for each addition smaller than 500 square feet to a single-family, two-family or townhouse dwelling unit.

1.0 credit for each addition of 500 square feet or larger to a single-family, two-family or townhouse dwelling unit.

Where Section R405, Simulated performance alternative, is used, the maximum allowable energy consumption shall be 92 percent of the value calculated according to Section R405.3.

**Appendix RB—Optional energy efficiency measures—Two step.** Building owners may choose to use this appendix to achieve an additional 12 percent savings in building energy use. The number of additional energy efficiency credits required by Section R406.3 would be increased by the following amounts:

2.0 credit for each new single-family, two-family and townhouse dwelling unit.

1.0 credit for each new dwelling unit within an R-2 occupancy building.

1.0 credit for each addition smaller than 500 square feet to a single-family, two-family or townhouse dwelling unit.

1.5 credit for each addition of 500 square feet or larger to a single-family, two-family or townhouse dwelling unit.

Where Section R405, Simulated performance alternative, is used, the maximum allowable energy consumption shall be 84 percent of the value calculated according to Section R405.3.