

# CHAPTER 1 [RE] SCOPE AND ADMINISTRATION

## User note:

**About this chapter:** Chapter 1 establishes the limits of applicability of this code and describes how the code is to be applied and enforced. Chapter 1 is in two parts: Part 1—Scope and Application (Sections R101–R102) and Part 2—Administration and Enforcement (Sections R103–R110). Section R101 identifies which buildings and structures come under its purview and references other I-Codes as applicable. Standards and codes are scoped to the extent referenced (see Section R108.1).

This code is intended to be adopted as a legally enforceable document, and it cannot be effective without adequate provisions for its administration and enforcement. The provisions of Chapter 1 establish the authority and duties of the code official appointed by the authority having jurisdiction and also establish the rights and privileges of the design professional, contractor and property owner.

## PART 1—SCOPE AND APPLICATION

### SECTION R101 SCOPE AND GENERAL REQUIREMENTS

**R101.1 Title.** This code shall be known as the *Energy Conservation Code* of the City of Aspen, Colorado and shall be cited as such. It is referred to herein as “this code.”

**R101.2 Scope.** This code applies to *residential buildings, building sites* and associated systems and equipment.

**R101.3 Intent.** This code shall regulate the design, construction, *repair, alteration*, change of occupancy, and *additions* of new and existing *buildings* for the reduction of greenhouse gas emissions and for the efficient production, use and storage 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 IECC—Commercial Provisions or IECC—Residential Provisions.

**R101.5 Compliance.** *Residential buildings* shall meet the provisions of IECC—Residential Provisions. *Commercial buildings* shall meet the provisions of IECC—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 alternative 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 conservation and safety. The *code official* shall respond to the applicant, in writing, stating the reasons why the alternative was *approved* or was not *approved*.

**R102.1.1 Above code programs.** The *code official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. *Buildings approved* in writing by such an energy-efficiency program shall be considered to be in compliance with this code where such buildings also meet the requirements identified in Table R405.2 and the proposed total *building thermal envelope* UA, which is the sum of U-factor times assembly area, shall be less than or equal to the *building thermal envelope* UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.23.

## PART 2—ADMINISTRATION AND ENFORCEMENT

### 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 on suitable material. Electronic media documents are permitted to be submitted where *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 the following as applicable:

1. Energy compliance path.
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and *solar heat gain coefficients* (SHGC).
4. Area-weighted *U*-factor and *solar heat gain coefficients* (SHGC) calculations.
5. Ratio of vertical fenestration area to above grade wall area enclosing conditioned space and ratio of skylight area to gross roof area over conditioned space.
6. Mechanical system design criteria.
7. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
8. Equipment and system controls.
9. Duct sealing, duct and pipe insulation and location.
10. Air sealing details.
11. Thermal bridges as identified in Section R402.2.13.
12. Location of pathways for routing of raceways or cable from the *solar ready zone* to the electrical distribution equipment.
13. Location reserved for inverters, metering equipment, *ESS*, and a pathway reserved for routing of raceways or conduit from the renewable energy system to the point of interconnection with the electrical service and the *ESS*.
14. Location and layout of a designated area for *ESS*.
15. Rated energy capacity and rated power capacity of the installed or planned *ESS*.
16. Location of and electrical system sizing for designated *EVSE* spaces, *EV Ready* spaces, and/or *EV Capable* parking spaces.

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

**R103.2.2 Solar-ready system.** The construction documents shall provide details for dedicated roof area, structural design for roof dead and live load, and routing of conduit or pre-wiring from solar-ready zone to electrical service panel.

**R103.2.3 ESS-ready system.** The construction documents shall indicate dedicated future *ESS* area and routing of conduit or pre-wiring from dedicated *ESS* area to electrical service panel.

**R103.2.4 EV infrastructure.** The construction documents shall indicate dedicated *EV ready* or *EV capable* parking space and routing of conduit or pre-wiring from parking space to electrical service panel.

**R103.2.5 Electric-ready system.** The construction documents shall indicate requirement for pre-wiring from cooking appliances and clothes dryers to electrical service panel.

**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 R104 FEES

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

**R104.2 Schedule of permit fees.** A permit shall not be valid until the fees prescribed by Section 2.12.100 the Aspen Municipal Code are paid in full.

**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* that shall be in addition to the required permit fees.

**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.

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

## SECTION R105 INSPECTIONS

**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.

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

**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.

**R105.2.2 Framing and air barrier rough-in inspection.** *Air barrier* inspections at framing and rough-in shall be made before application of air permeable insulation and shall verify compliance with the code as to air leakage controls as required by the code and *approved* plans and specifications. Air barriers located on the outside of the building may be inspected after cavity insulation is installed.

**R105.2.3 Insulation and fenestration rough-in inspection** Inspections at insulation and *fenestration* 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 such as U-factor and SHGC and proper installation.

**R105.2.4 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.

**R105.2.5 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 thermo- stats, dampers, whole-house ventilation, and minimum fan efficiency.

**Exception:** Systems serving multiple dwelling units shall be inspected in accordance with Section C105.2.4.

**R105.2.6 Electrical rough-in inspection.** Inspections shall verify lighting system controls, components, meters, and additional electric infrastructure as required by the code, *approved* plans and specifications. Inspections shall verify space availability and pathways to electrical service for future or installed energy storage systems. Inspections shall verify solar-ready zone and conduit or pre-wiring from the solar-ready zone to the electrical panel and proper panel space and capacity necessary for future installation of a solar photovoltaic system.

**R105.2.7 Final inspection.** The *building* shall have a final inspection and shall not be occupied until *approved*. The final inspection shall include verification of the installation of all required *building* systems, equipment and controls and their proper operation and the required number of high-efficacy lamps and fixtures.

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

**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 that such agencies are *approved* as to qualifications and reliability relevant to the *building* components and systems that they are inspecting.

**R105.4.1 Authorization of *approved* third-party inspection agency.** When authorized, and at the sole discretion of the authority having jurisdiction, the third-party inspection agency shall represent the jurisdiction and have powers as delegated by of the authority having jurisdiction.

**R105.4.1.1 Independence.** The *approved* third party shall be objective, competent and independent from the contractor responsible for the work being inspected. The *approved* third party shall disclose to the *building official* and the *registered design professional in responsible charge* possible conflicts of interest so that objectivity can be confirmed.

**R105.4.2 Approved third-party inspections scope.** When authorized, and at the sole discretion of the authority having jurisdiction, the authority having jurisdiction shall determine and delegate compliance verification measures the third-party inspection agency can perform.

**R105.4.3 Approved third-party inspections reporting.** The approved agency shall submit inspection reports to the authority having jurisdiction and to the owner's representative in accordance with International Building Code Section 104.4 before the Certificate of Occupancy can be issued.

**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.

**R105.6 Reinspection and testing.** Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made 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

**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*.

**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 R107 VALIDITY

**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 R108 REFERENCED STANDARDS

**R108.1 Referenced codes and standards.** The codes and standards referenced in this code shall be those indicated 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 R108.1.1 and R108.1.2.

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

**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.

**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.

**R108.3 Other laws.** The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

## **SECTION R109 STOP WORK ORDER**

**R109.1 Authority.** Where the *code official* finds any work regulated by this code being performed in a manner 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.

**R109.2 Issuance.** The stop work order shall be in writing and shall be given to the owner of the property, the owner's authorized agent or the person 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 is authorized to resume.

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

**R109.4 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 fines established by the authority having jurisdiction.

## **SECTION R110 MEANS OF APPEALS**

**R110.1 Appeals** shall be in accordance with Chapter 8.08 of the Aspen Municipal Code.

## CHAPTER 2 [RE] DEFINITIONS

### User note:

**About this chapter:** Codes, by their very nature, are technical documents. Every word, term and punctuation mark can add to or change the meaning of a technical requirement. It is necessary to maintain a consensus on the specific meaning of each term contained in the code. Chapter 2 performs this function by stating clearly what specific terms mean for the purpose of the code.

### 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*, or the *International Plumbing 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 more than 50 percent above grade and enclosing *conditioned space*. 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.

**ACCESS (TO).** 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.

**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.

**ALL-ELECTRIC BUILDING.** A building that contains no combustion equipment, or plumbing for *combustion equipment*, installed within the *building* or *building site*.

#### Exceptions:

1. Backup generators and associated plumbing.
2. Wood burning stoves and fireplaces in accordance with Aspen Municipal Code Title 13.

**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.

**APPLIANCE.** Any apparatus or device that utilizes a fuel or a raw material as a fuel to produce light, heat, power, refrigeration or air conditioning. Also, an apparatus that compresses fuel gases.

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

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

**APPROVED SOURCE.** An independent person, firm or corporation, approved by the code official, who is competent and experienced in the application of engineering principles to materials, methods or system analyses.

**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*").

**AUTOMATIC SHUT-OFF CONTROL.** A device capable of automatically turning loads off without manual intervention. Automatic shut-off controls include devices such as, but not limited to, occupancy sensors, vacancy sensors, door switches, programmable time switches (i.e., timeclocks), or count-down timers.

**AUTOMOBILE PARKING SPACE.** A space within a building or private or public parking lot, exclusive of driveways, ramps, columns, office and work areas, for the parking of an automobile

**BASEMENT WALL.** A wall 50 percent or more below grade and enclosing *conditioned space*.

**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 *basement walls, exterior 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.

**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 fixtures 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.

**COMBUSTION EQUIPMENT.** Any *equipment* or *appliance* used for space heating, service water heating, cooking, clothes drying and/or lighting that uses *fuel gas* or *fuel oil*.

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

**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.

**CONSTRUCTION DOCUMENTS.** Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building permit.

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

**CONTINUOUS INSULATION (ci).** 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*.

**CONTINUOUSLY BURNING PILOT LIGHT.** A small gas flame used to ignite gas at a larger burner. Once lit, a continuous pilot light remains in operation until manually interrupted.

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

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

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

**DEMAND RESPONSE SIGNAL.** A signal that indicates a price or a request to modify electricity consumption for a limited time period.

**DEMAND RESPONSIVE CONTROL.** A control capable of receiving and automatically responding to a demand response signal.

**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.

**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.

**ELECTRIC VEHICLE (EV).** An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a building electrical service, EVSE, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current.

**ELECTRIC VEHICLE CAPABLE SPACE (EV CAPABLE SPACE).** A designated automobile parking space that is provided with electrical infrastructure, such as, but not limited to, raceways, cables, electrical capacity, and panelboard or other electrical distribution equipment space, necessary for the future installation of an EVSE.

**ELECTRIC VEHICLE READY SPACE (EV READY SPACE).** An automobile parking space that is provided with a branch circuit and a receptacle outlet that will support an installed EVSE.

**ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE).** Equipment for plug-in power transfer including the ungrounded, grounded and equipment grounding conductors, and the electric vehicle connectors, attached plugs, personal protection system and all other fittings, devices, power outlets or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the electric vehicle.

**ELECTRIC VEHICLE SUPPLY EQUIPMENT INSTALLED SPACE (EVSE SPACE).** An automobile parking space that is provided with a dedicated EVSE connection.

**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 ASSESSMENT REPORT.** A report created by a building performance institute (BPI) certified energy analyst or other *approved* third party that analyzes the current condition and energy usage of a building or dwelling unit and provides a list of recommended improvements. The report shall include air leakage testing in accordance with section R402.4.1.2.

**ENERGY STORAGE SYSTEM (ESS).** One or more devices, assembled together, capable of storing energy in order to supply electrical energy at a future time.

**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*.

**EQUIPMENT.** Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

**ERI REFERENCE DESIGN.** A version of the *rated design* that meets the minimum requirements of the 2006 *International Energy Conservation Code*.

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

**EXTERIOR WALL ENVELOPE.** A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

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

**Skylights.** Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal including unit skylights, tubular daylighting devices, and glazing materials in solariums, sunrooms, roofs and sloped walls.

**Vertical fenestration.** Windows that are fixed or operable, opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of not less than 60 degrees (1.05 rad) from horizontal.

**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.

**FUEL GAS.** A natural gas, manufactured gas, liquified petroleum gas or a mixture of these.

**FUEL OIL.** Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

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

**HEAT PUMP.** A refrigeration system or factory-made appliance that utilizes refrigerant to transfer heat into a space or substance.

**HIGH-EFFICACY LIGHT SOURCES.** Any 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 BUILDING.** Any building or structure that is one or more of the following:

1. Listed, or certified as eligible for listing by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.
2. Designated as historic under an applicable state or local law.
3. Certified as a contributing resource within a National Register-listed, state-designated or locally designated historic district.

**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.

**INSULATED SIDING.** A type of continuous insulation with manufacturer-installed insulating material as an integral part of the cladding product having an *R*-value of not less than R-2.

**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 such 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.

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

**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 burner. 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 simulated building performance.

**RATED DESIGN.** A description of the proposed *building* used to determine the energy rating index.

**READY ACCESS (TO).** 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 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 and townhouses as well as *Group R-2, R-3 and R-4* buildings three stories or less in height above grade plane.

**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 an 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.** An *alteration* that includes the removal of all existing layers of roof assembly materials down to the roof deck and installing replacement materials above the existing roof deck.

**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 ( $h \times ft^2 \times ^\circ F/Btu$ ) [ $m^2 \times K/W$ ].

**SERVICE WATER HEATING.** Supply of hot water for purposes other than comfort heating.

**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 that is then reradiated, conducted or convected into the space.

**SOLAR-READY ZONE.** A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

**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.

**SUNROOM.** A one-story structure attached to a dwelling with a glazing area in excess of 40 percent of the gross area of the structure's *exterior walls* and roof.

**THERMAL BRIDGE.** An element or interface of elements that has a higher thermal conductivity than the surrounding building thermal envelope, which creates a path of least resistance for heat transfer.

**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 spaces*. The *conditioned spaces* 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 setpoint.

**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 ( $Btu/h \times ft^2 \times ^\circ F$ ) [ $W/(m^2 \times K)$ ].

**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.

**WORK AREA.** That portion or portions of a building consisting of all reconfigured spaces as indicated on the construction documents. Work area excludes other portions of the building where incidental work entailed by the intended work must be performed and portions of the building where work not initially intended by the owner is specifically required by this code.

**ZONAL HEATING.** A heating system in which each zone or room has a separate heater with a single controller in each zone.

**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

### User note:

**About this chapter:** Chapter 3 addresses broadly applicable requirements that would not be at home in other chapters having more specific coverage of subject matter. This chapter establishes climate zone by US counties and territories and includes methodology for determining climate zones elsewhere. It also contains product rating, marking and installation requirements for materials such as insulation, windows, doors and siding.

### SECTION R301 CLIMATE ZONES

**Section R301 Climate zones** is deleted in its entirety and shall read as follows: The City of Aspen, Colorado, shall use Climate Zone 7.

### 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.

### 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 that is 12 inches (305 mm) or greater in width. Alternatively, the insulation installers shall provide a certification that indicates the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown-in or sprayed fiberglass and cellulose insulation, the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be indicated on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered, and the *R*-value of the installed thickness shall be indicated on the certification. For insulated siding, the *R*-value shall be on a label on the product's package and shall be indicated 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*.**R303.1.1.1 Blown-in or sprayed roof and ceiling insulation.** The thickness of blown-in or sprayed fiberglass and cellulose roof and ceiling insulation shall be written in inches (mm) on markers that are installed at not less than one for every 300 square feet (28 m<sup>2</sup>) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. The thickness and installed *R*-value of sprayed polyurethane foam insulation shall be indicated on the 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 at 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 such as windows, doors and *skylights* shall be determined in accordance with NFRC 100.

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

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

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

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

FRAME TYPE	WINDOW AND GLASS DOOR		SKYLIGHT	
	Single pane	Double pane	Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

**TABLE R303.1.3(2) DEFAULT OPAQUE DOOR U-FACTORS**

DOOR TYPE	OPAQUE U-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, not exceeding 45% glazing, any glazing double pane	0.35

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

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

**R303.1.4 Insulation product rating.** The thermal resistance, *R*-value, of insulation shall be determined in accordance with Part 460 of US-FTC CFR Title 16 in units of  $h \times ft^2 \times ^\circ F/Btu$  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 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.** Materials, systems and equipment shall be installed in accordance with the manufacturer’s instructions and the *International Building Code*. Insulation shall meet the requirements of the Grade I standard in ICC/RESNET 301 Normative Appendix A.

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

**R303.3 Maintenance information.** 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 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.



# CHAPTER 4 [RE]

## RESIDENTIAL ENERGY EFFICIENCY

### User note:

**About this chapter:** Chapter 4 presents the paths and options for compliance with the energy efficiency provisions. Chapter 4 contains energy efficiency provisions for the building envelope, mechanical and water heating systems, lighting and additional efficiency requirements. A performance alternative, energy rating alternative, and tropical regional alternative are also provided to allow for energy code compliance other than by the prescriptive method.

### SECTION R401 GENERAL

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

**R401.2 Application.** Residential buildings shall comply with either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

**Exception:** Additions, *alterations*, repairs and changes of occupancy to existing buildings complying with Chapter 5.

**R401.2.1 Prescriptive Compliance Option.** The Prescriptive Compliance Option requires compliance with Sections R401 through R404.

**R401.2.2 Total Building Performance Option.** The Total Building Performance Option requires compliance with Section R405.

**R401.2.3 Energy Rating Index Option.** The Energy Rating Index (ERI) Option requires compliance with Section R406.

**R401.2.5 Additional energy efficiency.** This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For buildings complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2.
2. For buildings complying with Section R401.2.2, the building shall meet one of the following:
  - 2.1. One of the additional efficiency package options in Section R408.2 shall be installed without including such measures in the proposed design under Section R405; or
  - 2.2. The proposed design of the building under Section R405.2 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.
3. For buildings complying with the Energy Rating Index Alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.

The option selected for compliance shall be identified in the certificate required by Section R401.3.

**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*. Where 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. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces*.
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, 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 performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or base-board electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.

6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted, the compliance path used, and where applicable, the additional efficiency measures selected for compliance with Section R408.
8. Where a solar-ready zone is provided, the certificate shall indicate the location, and dimensions.

**SECTION R402  
BUILDING THERMAL ENVELOPE**

**R402.1 General.** The *building thermal envelope* shall comply with the requirements of Sections R402.1.1 through R402.1.5.

**Exceptions:**

1. The following *low-energy buildings*, or portions thereof, separated from the remainder of the building by *building thermal envelope* assemblies complying with this section shall be exempt from the *building thermal envelope* provisions of Section R402.
  - 1.1. 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.
  - 1.2. Those that do not contain *conditioned space*.

**R402.1.1 Vapor retarder.** Wall assemblies in the *building thermal envelope* shall comply with the vapor retarder requirements of Section 1404.3 of the *International Building Code*, as applicable.

**R402.1.2 Insulation and fenestration criteria.** The *building thermal envelope* shall meet the requirements of Table R402.1.2, 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 and glazed fenestration SHGC equal to or less than that specified in Table R402.1.2.

**R402.1.3 R-value alternative.** 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

**R402.1.4 R-value computation.** Cavity insulation alone shall be used to determine compliance with the cavity insulation *R*-value requirements in Table R402.1.3. Where cavity insulation is installed in multiple layers, the *R*-values of the cavity insulation layers shall be summed to determine compliance with the cavity insulation *R*-value requirements. The manufacturer's settled *R*-value shall be used for blown-in 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 R402.1.3, the manufacturer's labeled *R*-value for the insulated siding shall be reduced by R-0.6.

**TABLE R402.1.2  
MAXIMUM ASSEMBLY U-FACTORS<sup>a</sup> AND FENESTRATION REQUIREMENTS**

WORK TYPE	FENESTRATION U-FACTOR <sup>f</sup>	SKYLIGHT U-FACTOR	GLAZED FENESTRATION SHGC <sup>d, e, f</sup>	CEILING U-FACTOR	WOOD FRAME WALL U-FACTOR	MASS WALL U-FACTOR <sup>b</sup>	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
New Construction & Additions	0.26 <sup>h,i</sup>	0.44	0.35	0.018 <sup>g</sup>	0.027	0.036	0.026	0.034	0.034
Alterations	0.28	0.50	0.35	0.026	0.049	0.057	0.028	0.050	0.055



For SI: 1 foot = 304.8 mm.

- a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed
  - 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
- c. In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.
- d. The SHGC column applies to all glazed fenestration.
 

**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.
- e. There are no SHGC requirements in the Marine Zone.
- f.
- g. Ceilings with attics may use an equivalent *U*-factor of 0.024.

Vertical fenestration shall also comply with R402.3.6 and R402.3.7. Doors may have a *U*-factor of 0.28 or less.

**TABLE R402.1.3  
INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

WORK TYPE	FENESTRATION U-FACTOR <sup>b, i</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b, o</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE <sup>g</sup>	MASS WALL R-VALUE <sup>h</sup>	FLOOR R-VALUE	BASEMENT <sup>c, g</sup> WALL R-VALUE	SLAB <sup>d</sup> EDGE R-VALUE & DEPTH	CRAWL SPACE <sup>c, g</sup> WALL R-VALUE
New Construction & Additions	0.26 <sup>i, j, k</sup>	0.44	0.35	60	<sup>hhh</sup> 34+12ci or 20 + 20ci or 13 + 25ci	25ci	38	20ci or 5 + 15ci or 13 + 10ci	10ci, 4 ft	20ci or + 15ci or 13 + 10ci
Alterations	0.28 <sup>l</sup>	0.50	0.35	49	30 or 20+5ci <sup>hhg</sup> or 13+10ci <sup>hhg</sup> or 0+20ci <sup>hhg</sup>	19/21	38	10ci or 13	10ci, 4 ft	10ci or 13

For SI: 1 foot = 304.8 mm. NR = Not Required.

ci = continuous insulation.

- a. *R*-values are minimums. *U*-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall be not less than the *R*-value specified in the table.
- b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- c. R-10 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs as indicated in the table. The slab-edge insulation for heated slabs shall not be required to extend below the slab.
- d. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, “13 + 5” means R-13 cavity insulation plus R-5 continuous insulation.
- e. Mass walls shall be in accordance with Section R402.2.5. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

Vertical fenestration shall also comply with R402.3.6 and R402.3.7. Doors may have a *U*-factor of 0.28 or less.

**R402.1.5 Total UA alternative.** Where the total *building thermal envelope UA*, the sum of *U*-factor times assembly area, is less than or equal to the total UA resulting from multiplying the *U*-factors in Table R402.1.2 by the same assembly area as in the proposed *building*, the *building* shall be considered to be in compliance with Table R402.1.2. The UA calculation shall be performed using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements of Table R402.1.2 and the maximum fenestration *U*-factors of Section R402.5 shall be met.

If using REScheck software to show compliance with this alternative path for the 2021 edition of the code, the proposed design must be a minimum of 23% more efficient than the standard reference design in order to accommodate the amended values.

**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 R402.2.13.

**R402.2.1 Ceilings with attic spaces.** Where Section R402.1.3 requires R-49 insulation in the ceiling or attic, installing R-38 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Where Section R402.1.3 requires R-60 insulation in the ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49

insulation extends over the wall top plate at the eaves. This reduction shall not apply to the insulation and fenestration criteria in Section R402.1.2 and the Total UA alternative in Section R402.1.5.

**R402.2.3 Eave baffle.** For air-permeable insulation in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain 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 to unconditioned spaces such as attics and crawl spaces shall be insulated to the same *R*-value required by Table R402.1.3 for the wall or ceiling in which they are installed.

**Exceptions:**

1. Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table R402.1.3 based on the applicable climate zone specified in Chapter 3.
2. Horizontal pull-down, stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces in Climate Zones 0 through 4 shall not be required to comply with the insulation level of the surrounding surfaces provided the hatch meets all of the following:
  - 2.1. The average *U*-factor of the hatch shall be less than or equal to U-0.10 or have an average insulation *R*-value of R-10 or greater.
  - 2.2. Not less than 75 percent of the panel area shall have an insulation *R*-value of R-13 or greater.
  - 2.3. The net area of the framed opening shall be less than or equal to 13.5 square feet (1.25 m<sup>2</sup>).
  - 2.4. The perimeter of the hatch edge shall be weatherstripped.

The reduction shall not apply to the total UA alternative in Section R402.1.5.

**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 prevents damaging or compressing the insulation shall be provided to all equipment. Where loose-fill insulation is installed, a wood-framed or equivalent baffle, retainer, or dam shall be installed to prevent loose-fill insulation from spilling into living space from higher to lower sections of the attic and from attics covering conditioned spaces to unconditioned spaces. The baffle or retainer shall 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* shall be one of the following:

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

**R402.2.6 Steel-frame ceilings, walls and floors.** Steel-frame ceilings, walls, and floors shall comply with the insulation requirements of Table R402.2.6 or the *U*-factor requirements of Table R402.1.2. The calculation of the *U*-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

**TABLE R402.2.6  
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION R-VALUES**

WOOD FRAME R-VALUE REQUIREMENT	COLD-FORMED STEEL-FRAME EQUIVALENT R-VALUE <sup>a</sup>
Steel Truss Ceilings <sup>b</sup>	
R-49	R-38 + 5
R-60	R-49 + 10
Steel Joist Ceilings <sup>b</sup>	

R-49	R-49 + 10
R-60	R-49 + 20
Steel-frame Wall, 16 inches on center	
R-32 + 12	R-19 + 25
Steel-frame Wall, 24 inches on center	
R-32 + 12	R-19 + 18
Steel Joist Floor	
R-38	R-30 + 25

- a. The first value is cavity insulation *R*-value; the second value is continuous insulation *R*-value. Therefore, for example, “R-30 + 3” means R-30 cavity insulation plus R-3 continuous insulation.
- b. Insulation exceeding the height of the framing shall cover the framing.

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

1. Installation 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.
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.
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.

**R402.2.8 Basement walls.** Basement walls shall be insulated in accordance with Table R402.1.3.

**Exception:** Basement walls associated with unconditioned basements where all of the following requirements are

met:

1. The floor overhead, including the underside stairway stringer leading to the basement, is insulated in accordance with Section R402.1.3 and applicable provisions of Sections R402.2 and R402.2.7.
2. There are no uninsulated duct, domestic hot water, or hydronic heating surfaces exposed to the basement.
3. There are no HVAC supply or return diffusers serving the basement.
4. The walls surrounding the stairway and adjacent to conditioned space are insulated in accordance with Section R402.1.3 and applicable provisions of Section R402.2.
5. The door(s) leading to the basement from conditioned spaces are insulated in accordance with Sections R402.1.3 and applicable provisions of Section R402.2, and weatherstripped in accordance with Section R402.4.
6. The building thermal envelope separating the basement from adjacent conditioned spaces complies with Section R402.4.

**R402.2.8.1 Basement wall insulation installation.** Where *basement walls* are insulated, the insulation shall be installed from the top of the *basement wall* down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less.

**R402.2.9 Slab-on-grade floors.** Slab-on-grade floors with a floor surface less than 24 inches (305 mm) below grade shall be insulated in accordance with Table R402.1.3. Heated slab-on-grade floors shall be insulated in accordance with Table R402.1.3 footnote d regardless of depth below grade.

**R402.2.9.1 Slab-on-grade floor insulation installation.** Where installed, the insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.3 or the distance of the proposed design, as applicable, by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the *exterior wall* and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the *exterior wall*.

**R402.2.10 Crawl space walls.** Crawl space walls shall be insulated in accordance with Table R402.1.3.

**Exception:** Crawl space walls associated with a crawl space that is vented to the outdoors and the floor overhead is insulated in accordance with Table R402.1.3 and Section R402.2.7.

**R402.2.10.1 Crawl space wall insulation installations.** Where crawl space wall insulation is installed, it shall be permanently fastened to the wall and shall extend downward from the floor to the finished grade elevation and then vertically or horizontally for not less than an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *International Building Code*. Joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up stem walls and shall be attached to the stem walls.

**R402.2.11 Masonry veneer.** Insulation shall not be required on the horizontal portion of a foundation that supports a masonry veneer.

**R402.2.12 Sunroom and heated garage insulation.** *Sunrooms* enclosing *conditioned space* and heated garages shall meet the insulation requirements of this code.

**Exception:** For *sunrooms* and heated garages provided *thermal isolation*, and enclosed *conditioned space*, the following exceptions to the insulation requirements of this code shall apply:

1. The minimum ceiling insulation *R*-value shall be R-24. Ceilings separating a *sunroom* or heated garage with *thermal isolation* from *conditioned space* shall comply with the *building thermal envelope* requirements of this code.
2. The minimum wall insulation *R*-value shall be R-13. Walls separating a *sunroom* or heated garage with *thermal isolation* from *conditioned space* shall comply with the *building thermal envelope* requirements of this code.

**R402.2.13 Thermal bridges in above-grade walls.** Thermal bridges in above-grade walls shall comply with Sections R402.2.13.1 through R402.13.3 or an *approved* design.

**Exceptions:**

1. Any thermal bridge with a material thermal conductivity not greater than 3.0 Btu/h-ft-°F.
2. Blocking, coping, flashing, and other similar materials for attachment of roof coverings.
3. Thermal bridges accounted for in the U-factor or C-factor for a building thermal envelope.

**R402.2.13.1 Balconies and floor decks.** Balconies and concrete floor decks shall not penetrate the building thermal envelope. Such assemblies shall be separately supported or shall be supported by *approved* structural attachments or elements that minimize thermal bridging through the building thermal envelope.

**Exceptions:** Balconies and concrete floor decks shall be permitted to penetrate the building thermal envelope where:

1. an area-weighted U-factor is used for above-grade wall compliance which includes a U-factor of 0.8 Btu/h-°F-ft<sup>2</sup> for the area of the above-grade wall penetrated by the concrete floor deck, or
2. an approved thermal break device of not less than R-10 is installed in accordance with the manufacturer's instructions.

**R402.2.13.2 Cladding supports.** Linear elements supporting opaque cladding shall be off-set from the structure with attachments that allow the continuous insulation, where present, to pass behind the cladding support element.

**Exceptions:**

1. An approved design where the above-grade wall U-factor used for compliance accounts for the cladding support element thermal bridge.
2. Anchoring for curtain wall and window wall systems.

**R402.2.13.3 Structural beams and columns.** Structural steel and concrete beams and columns that project through the building thermal envelope shall be covered with not less than R-5 insulation for not less than 2-feet (610 mm) beyond the interior or exterior surface of an insulation component within the building thermal envelope.

**Exceptions:**

1. Where an approved thermal break device is installed in accordance with the manufacturer's instructions.
2. An approved design where the above-grade wall U-factor used to demonstrate compliance accounts for the beam or column thermal bridge.

**R402.3 Fenestration.** In addition to the requirements of Section R402.1, fenestration shall comply with Sections R402.3.1 through R402.3.7.

**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.

Dynamic glazing shall be permitted to satisfy the SHGC requirements of Table R402.1.2 provided that the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the *dynamic glazing* is automatically controlled to modulate the amount of solar gain into the space in multiple steps. *Dynamic glazing* shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall be prohibited.

**Exception:** Dynamic glazing shall not be required to comply with this section where both the lower and higher labeled SHGC comply with the requirements of Table R402.1.2.

**R402.3.3 Glazed fenestration exemption.** Not greater than 15 square feet (1.4 m<sup>2</sup>) of glazed fenestration per *dwelling unit* shall be exempt from the *U*-factor and SHGC requirements in Section R402.1.2. This exemption shall not apply to the Total UA alternative in Section R402.1.5.

**R402.3.4 Opaque door exemption.** One side-hinged or pivot opaque door assembly not greater than 40 square feet (2.22 m<sup>2</sup>) in area shall be exempt from the *U*-factor requirement in Section R402.1.2. This exemption shall not apply to the Total UA alternative in Section R402.1.5.

**R402.3.5 Sunroom and heated garage fenestration.** *Sunrooms* and heated garages enclosing *conditioned space* shall comply with the fenestration requirements of this code.

**Exception:** *Sunrooms* and heated garages with *thermal isolation* and enclosing *conditioned space*, the fenestration *U*-factor shall not exceed 0.45 and the skylight *U*-factor shall not exceed 0.70. This fenestration will count toward the maximum area in section R402.3.6.

New fenestration separating a *sunroom* or heated garage with *thermal isolation* from *conditioned space* shall comply with the *building thermal envelope* requirements of this code.

**R402.3.6 Maximum area.** The vertical fenestration area, not including opaque doors and opaque spandrel panels, shall be not greater than 30 percent of the gross above grade wall area enclosing conditioned space. The skylight

area shall be not greater than 3 percent of the gross roof area over conditioned space.

**R402.3.7 Panes.** Vertical fenestration shall be triple glazed with a minimum of one factory applied low-e coating.

**Exceptions:**

1. Vertical fenestration that meets the U-factor of table R402.1.3 using air fill.
2. Doors.

**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 R402.4.5.

**R402.4.1 Building thermal envelope.** The *building thermal envelope* shall comply with Sections R402.4.1.1 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 indicated in Table R402.4.1.1 shall be installed in accordance with the manufacturer’s instructions and the criteria indicated 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.

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

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, <i>R</i> -value, of not less than R-3 per inch. 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 framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier. <sup>b</sup> The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim joist. <sup>b</sup>
Floors, including cantilevered floors and floors above garages	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 floor sheathing. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or Continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10. Penetrations through masonry and concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section . 1404.3 of the <i>International Building Code</i>	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 R402.2.9.1

Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed.  Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required <i>R</i> -value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.

- a. Inspection of log walls shall be in accordance with the provisions of ICC 400.
- b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

**R402.4.1.2 Testing** The *building* or each *dwelling unit* in the building shall be tested for air leakage. <sup>322</sup>Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

**Exception:**

1. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall have *thermal isolation* from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.

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, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

<sup>322</sup>Mechanical ventilation shall be provided in accordance with Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other *approved* means of ventilation.

**R402.4.1.3 Maximum air leakage rate.** The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 m<sup>3</sup>/(s × m<sup>2</sup>)] of dwelling unit enclosure area.

**R402.4.1.4 Prescriptive air leakage rate.** When complying with Section R401.2.1, the building or dwelling unit shall have an air leakage rate not exceeding 1.5 air changes per hour, when tested in accordance with Section R402.4.1.2.

**Exception:** When testing individual *dwelling units*, an air leakage rate not exceeding 0.27 cubic feet per minute per square foot of the *dwelling unit* enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be an accepted alternative for:

- 1.1 Multiple- family building *dwelling units*.
- 1.2 *Dwelling units* that are 1,500 square feet (139.4 m<sup>2</sup>) or smaller.

**R402.4.2 Fireplaces.** New wood-burning fireplaces shall comply with Aspen Municipal Code Title 13 and be installed per manufacturer's instructions.

**R402.4.3 Fenestration air leakage.** Windows, *skylights* and sliding glass doors shall have an air infiltration rate of not greater than 0.3 cfm per square foot (1.5 L/s/m<sup>2</sup>), and for swinging doors, not greater than 0.5 cfm per square foot (2.6 L/s/m<sup>2</sup>), when tested in accordance with NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and *listed* and *labeled* by the manufacturer.

**Exception:** Site-built windows, *skylights* and doors.

**R402.4.4 Rooms containing fuel-burning appliances.** Where open combustion air ducts provide combustion air to open combustion fuel-burning appliances, the appliances and combustion air opening shall be located outside the *building thermal envelope* or enclosed in a room that is isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.3, where the walls, floors and ceilings shall meet a minimum of the *basement wall R-value* requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through *conditioned space* to an *R-value* of not less than R-8.

**Exceptions:**

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.
2. Wood burning fireplaces and stoves complying with Aspen Municipal Code Title 13 and installed per manufacturer's instructions.

**R402.4.5 Recessed lighting.** Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and *unconditioned spaces*. Recessed luminaires shall be IC-rated and *labeled* as having an air leakage rate of not greater than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E283 at a pressure differential of 1.57 psf (75 Pa). Recessed luminaires shall be sealed with a gasket or caulked 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 and SHGC.** The area-weighted average maximum fenestration *U-factor* permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.40 for vertical fenestration, and 0.75 for skylights.

## SECTION R403 SYSTEMS

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

**R403.1.1 Programmable thermostat.** The thermostat controlling the primary heating and cooling system of the *dwelling unit* shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of day and different days of the week. This thermostat shall include the capability to set back or temporarily operate the system to maintain *zone* temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).

**R403.1.2 Heat pump supplementary heat.** Heat pumps having combustion equipment or electric resistance equipment for supplementary space heating shall have controls that are configured to prevent supplemental heat operation when the capacity of the heat pump compressor can meet the heating load and limit supplemental heat operation to only those times when one of the following applies:

1. For space heating systems, the vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.

**Exception:** For forced-air systems, the vapor compression cycle cannot provide a supply air temperature of 85°F or greater

2. The heat pump is operating in defrost mode.



3. The vapor compression cycle malfunctions.
4. For space heating systems, the thermostat malfunctions.

**R403.1.3 Continuously burning pilot light** Gas fireplace systems and heaters are not permitted to be equipped with a *continuously burning pilot light*.

**Exception:** Any fireplace or heater equipped with an *on-demand, intermittent or interrupted ignition pilot light* (as defined in ANSI Z21.20) is not considered to have a *continuously burning pilot light*.

**R403.2 Hot water boiler temperature reset.** The manufacturer shall equip each gas, oil and electric boiler (other than a boiler equipped with a tankless domestic water heating coil) with 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 Ducts located outside conditioned space.** Supply and return ducts located outside *conditioned space* shall be insulated to an *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. Underground ducts utilizing the thermal distribution efficiency method shall be listed and *labeled* to indicate the *R*-value equivalency.

**R403.3.2 Ducts located in conditioned space.** For ductwork to be considered inside a *conditioned space*, it shall comply with one of the following:

1. The duct system shall be located completely within the *continuous air barrier* and within the building thermal envelope.
2. Ductwork in ventilated attic spaces shall be buried within ceiling insulation in accordance with Section R403.3.3 and all of the following conditions shall exist:
  - 2.1. The air handler is located completely within the *continuous air barrier* and within the *building thermal envelope*.
  - 2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post- construction total system leakage test to outside the *building thermal envelope* in accordance with Section R403.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m<sup>2</sup>) of *conditioned floor area* served by the duct system.
  - 2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.
3. Ductwork in floor cavities located over unconditioned space shall comply with all of the following:
  - 3.1. A *continuous air barrier* installed between unconditioned space and the duct.
  - 3.2. Insulation installed in accordance with Section R402.2.7.
  - 3.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.
4. Ductwork located within *exterior walls* of the *building thermal envelope* shall comply with the following:
  - 4.1. A *continuous air barrier* installed between unconditioned space and the duct.
  - 4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing or a minimum R5 Continuous insulation on the exterior side of the wall.
  - 4.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

**R403.3.3 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.

**R403.3.3.1 Effective R-value of deeply buried ducts.** Where using the Total Building Performance Compliance Option in accordance with Section R401.2.2, sections of ducts that are installed in accordance with Section R403.3.3, 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.

**R403.3.4 Sealing.** Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with the *International Mechanical Code*

**R403.3.4.1 Sealed air handler.** Air handlers shall have a manufacturer's designation for an air leakage of not greater than 2 percent of the design airflow rate when tested in accordance with ASHRAE 193.

**R403.3.5 Duct testing.** Ducts shall be pressure tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

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

**Exceptions:**

1. A duct air-leakage test shall not be required for ducts serving ventilation systems that are not integrated with ducts serving heating or cooling systems.
2. A duct air-leakage test shall not be required for ducts located entirely within the thermal envelope.

**R403.3.6 Duct leakage.** The total leakage of the ducts, where measured in accordance with Section R403.3.5, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m<sup>2</sup>) of *conditioned floor area* where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3.0 cubic feet per minute (85 L/min) per 100 square feet (9.29 m<sup>2</sup>) of *conditioned floor area*.
2. Postconstruction test: Total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m<sup>2</sup>) of *conditioned floor area*.
3. Test for ducts within thermal envelope: 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*.

**R403.3.7 Building cavities.** *Building* framing cavities shall not be used as ducts or plenums.

**R403.4 Mechanical system piping insulation.** Mechanical system piping capable of carrying fluids greater than 105°F (41°C) or less than 55°F (13°C) shall be insulated to an *R*-value of not less than R-3.

**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. The protection shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall be prohibited.

**R403.5 Service hot water systems.** Energy conservation measures for service hot water systems shall be in accordance with Sections R403.5.1 through R403.5.3.

**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 in a location with access. Manual controls shall be 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 thermosyphon circulation systems shall be prohibited. Controls for circulating hot water system pumps 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).

**R403.5.1.1.1 Demand recirculation water systems.** Where installed, *demand recirculation water systems* shall have controls that 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.

**R403.5.1.2 Heat trace systems.** Electric heat trace systems shall comply with IEEE 515.1 or UL 515, as well as the requirements of R403.11. 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 Hot water pipe insulation.** Insulation for service hot water piping with a thermal resistance, *R*- value, of not less than R-3 shall be applied to the following:

1. Piping  $\frac{3}{4}$  inch (19.1 mm) and larger in nominal diameter located inside the *conditioned space*.
2. Piping serving more than one dwelling unit.
3. Piping located outside the *conditioned space*.
4. Piping from the water heater to a distribution manifold.
5. Piping located under a floor slab.
6. Buried piping.
7. Supply and return piping in circulation and recirculation systems other than cold water pipe return demand recirculation systems.

**R403.5.3 Drain water heat recovery units.** Where installed, drain water heat recovery units shall comply with CSA B55.2. Drain water heat recovery units shall be tested in accordance with CSA B55.1. Potable water-side pressure loss of drain water heat recovery units shall be less than 3 psi (20.7 kPa) for individual units connected to one or two showers. Potable water-side pressure loss of drain water heat recovery units shall be less than 2 psi (13.8 kPa) for individual units connected to three or more showers.

**R403.6 Mechanical ventilation.** New *buildings* complying with Section R402.4.1 shall be provided with *ventilation* that complies with the requirements of 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 Heat or energy recovery ventilation.** *Dwelling units* shall be provided with a heat recovery (HRV) or energy recovery (ERV) ventilation system . The system shall be a balanced ventilation system with a minimum sensible heat recovery efficiency of 65 percent at 32°F (0°C) at an airflow greater than or equal to the design airflow. The SRE shall be determined from a listed value or from interpolation of listed values.

**R403.6.2 Whole-dwelling mechanical ventilation system fan efficacy.** Fans used to provide whole-dwelling mechanical ventilation shall meet the efficacy requirements of Table R403.6.2 at one or more rating points. Fans shall be tested in accordance with the test procedure referenced by Table R403.6.2 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 or 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).TABLE R403.6.2

**WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY<sup>a</sup>**

FAN LOCATION	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE
HRV, ERV	Any	1.2	CAN/CSA 439
Range hood	Any	2.8	ASHRAE 51 (ANSI/AMCA Standard 210)
In-line supply or exhaust fan	Any	3.8	
Other exhaust fan	< 90	2.8	
	≥ 90 and < 200	3.5	
	≥ 200	4.0	
Air-handler that is integrated to tested and <i>listed</i> HVAC equipment	Any	1.2	Outdoor airflow as specified. Air-handler fan power determined in accordance with the HVAC appliance's test method referenced by Section C403.3.2 of the IECC-Commercial Provisions.

a. Design outdoor airflow rate/watts of fan used.

**R403.6.3 Testing.** Mechanical ventilation systems used to provide the required whole-dwelling mechanical ventilation shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6, in accordance with ANSI/RESNET/ICC 380. 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:** A third-party test shall not be required where the ventilation system has an integrated diagnostic tool used for airflow measurement, programmable airflow settings, and a user interface that communicates the installed airflow rate.

**R403.7 Packaged and split system cooling equipment.** Where forced air systems are provided with split system cooling equipment, that equipment shall be a heat pump sized and configured to provide primary heat for the forced air system.

**R403.8 Systems serving multiple dwelling units.** Systems serving multiple *dwelling units* shall comply with Sections C403 and C404 of the *International Energy Conservation Code*—Commercial Provisions instead of Section R403.

**R403.9 Snow and ice melting systems** Snow- and ice-melting systems shall comply with R403.9.1 through R403.9.3.  
**R403.9.1 Snow melt and ice system controls.** Snow- and ice- melting systems shall include automatic controls that are configured to shut off the system when the temperature of the snowmelted surface is greater than 40°F (10°C) and precipitation is not falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is greater than 40°F (4°C).

**Exception:** Heat mats that are controlled by a factory installed thermostat configured to energize the mat when the outdoor temperature is less than 35°F maximum and configured to deenergize the mat when the outdoor temperature is greater than 50°F maximum.

**R403.9.2 Insulation.** R-10 insulation shall be installed under the snow melted surface.

**Exceptions:**

1. Integrated pedestal system products over conditioned space or on above grade decks with minimum R-4 integral insulation plus minimum R-6 insulation under the air space.
2. Heat mats

**R403.9.3 Equipment.** Electric resistance and heat pump heaters are permitted. Where condensing boilers are used, the boiler supply water temperature shall be 130°F maximum to allow for efficient boiler operation.

**R403.10 Roof and gutter deicing controls.** Roof and gutter deicing systems, including but not limited to self-regulating cable, shall include automatic controls configured to shut off the system when the outdoor temperature is above 40°F (4°C). Such controls shall include one of the following:

1. A moisture sensor configured to shut off the system in the absence of moisture, or
2. A daylight sensor or other means configured to shut off the system between sunset and sunrise.

**R403.11 Freeze protection system controls.** Freeze protection systems, such as heat tracing of outdoor piping and heat exchangers, including self-regulating heat tracing, shall include automatic controls that are configured to shutoff the systems when the outdoor air temperature is greater than 40°F (4°C) or when the conditions of the protected fluid will prevent freezing.

**R403.12 Energy consumption of pools and spas.** The energy consumption of pools and permanent spas shall be controlled by the requirements in Sections R403.10.1 through R403.10.3.

**R403.12.1 Heaters.** The electric power to heaters shall be controlled by an 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 setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall comply with Section R403.1.3. Electric resistance and heat pump heaters are permitted. Where condensing boilers are used, the boiler supply water temperature shall be a maximum of 130F to allow for efficient boiler operation.

**R403.12.2 Time switches.** Time switches or other control methods that can automatically turn heaters and pump motors off and on 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 in compliance with this section.

**Exceptions:**

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

**R403.12.3 Covers.** Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant

cover with minimum insulation value of R-2.

**R403.13 Portable spas.** The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

**R403.13.1 Covers.** Portable spas shall be provided with a cover with a minimum insulation value of R-12.

**R403.14 Residential pools and permanent residential spas.** Where installed, the energy consumption of residential swimming pools and permanent residential spas shall be controlled in accordance with the requirements of APSP 15. Swimming pools and permanent spas shall have insulation on the sides and bottom surfaces located on the exterior. The type of insulation shall be impermeable and impervious to water logging or saturation and unaffected by water, mold, mildew, and have capability to resist compression. The insulation value shall be a minimum of R-15.

**R403.15 Heating outside a building.** Systems installed to provide heat outside a building shall be electric systems or gas fireplaces or firepits. Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically de-energized when occupants are not present.

**R403.16 Cooling outside a building.** Systems to provide cooling outside the building thermal envelope shall not be permitted.

## **SECTION R404 ELECTRICAL POWER, LIGHTING, STORAGE, AND RENEWABLE ENERGY SYSTEMS**

**R404.1 Lighting equipment.** All permanently installed lighting fixtures, excluding kitchen appliance lighting fixtures, shall contain only high-efficacy lighting sources.

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

### **Exceptions:**

1. Detached one- and two- family dwellings.
2. Townhouses.
3. Solar-powered lamps not connected to any electrical service.
4. Luminaires controlled by a motion sensor.
5. Lamps and luminaires that comply with Section R404.1.

**R404.1.2 Fuel gas lighting equipment.** Fuel gas lighting systems shall not be permitted .

**R404.2 Interior lighting controls.** All permanently installed luminaires shall be controlled as required in Sections R404.2.1 and R404.2.2 **Exception:** Lighting controls shall not be required for the following:

1. Bathrooms.
2. Hallways.
3. Lighting designed for safety or security, including stairway illumination.

**R404.2.1 Habitable spaces** All permanently installed luminaires in habitable spaces shall be controlled with a dimmer or an automatic shut-off control capable of automatically turning off lights within 20 minutes after all occupants have left the space and shall incorporate a manual control to allow occupants to turn the lights on or off.

**R404.2.2 Specific locations** All permanently installed luminaires in garages, laundry rooms, utility rooms, storage rooms, crawlspaces, and unfinished spaces in basements and attics shall be controlled by an automatic shut-off control that automatically turns off lights within 20 minutes after all occupants have left the space and shall incorporate a manual control to allow occupants to turn the lights on or off.

**R404.3 Exterior lighting controls.** Exterior lighting controlled from within individual *dwelling units* shall comply with Section R404.3.1. Controls for all other exterior lighting shall comply with Sections C405.2.7

**R404.3.1 Controls for individual dwelling units .** 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.
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.

**R404.4 Electric readiness of systems using fossil fuel:** household clothes dryers and conventional cooking tops or conventional ovens shall comply with the requirements of Sections R404.4.1 through R404.4.3.

**R404.4.1 Cooking appliances.** An individual branch circuit receptacle outlet with a rating not less than 240-volts,

40-amperes shall be installed, and terminate within three feet of conventional cooking tops, conventional ovens or cooking appliances combining both.

**Exception:** Cooking appliances not installed in a dwelling unit.

**R404.4.2 Household clothes dryers.** An individual branch circuit receptacle outlet with a rating not less than 240-volts, 30-amperes shall be installed, and terminate within three feet (304 mm) of each household clothes dryer.

**Exception:** Clothes dryers that serve more than one dwelling unit and are located outside of a dwelling unit.

**R404.4.3 Electrification-ready circuits.** The unused conductors required by Sections R404.4.1 through R404.4.2 shall be labeled with the word "spare." Space shall be reserved in the electrical panel in which the branch circuit originates for the installation of an overcurrent device. Capacity for the circuits required by Sections R404.4.1 through R404.4.2 shall be included in the load calculations of the original installation.

**R404.5 Renewable energy infrastructure.** The building shall comply with the requirements of R404.5.1 or R404.5.2.

**R404.5.1 One- and two- family dwellings and townhouses.** One- and two-family dwellings and townhouses shall comply with Sections R404.5.1.1 through R404.5.1.4.

**Exceptions:**

1. A dwelling unit with a permanently installed on-site renewable energy system.
2. A dwelling unit with less than 500 square feet (46m<sup>2</sup>) of roof area oriented between 110 degrees and 270 degrees of true north.
3. Dwelling units where 50 percent of the solar-ready area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.

**R404.5.1.1 Solar-ready zone area.** The total area of the solar-ready zone shall not be less than 250 square feet (23.2 m<sup>2</sup>) and shall be composed of areas not less than 5.5 feet (1676 mm) in one direction and not less than 80 square feet (7.4 m<sup>2</sup>) exclusive of access or set back areas as required by the International Fire Code.

**Exception:** Dwelling units in townhouses three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 square feet (186m<sup>2</sup>) per dwelling shall be permitted to have a solar-ready zone area of not less than 150 square feet (14 m<sup>2</sup>).

**R404.5.1.2 Obstructions.** Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

**R404.5.1.3 Electrical service reserved space.** The main electrical service panel shall have a reserved space for a dual pole circuit breaker and shall be labeled "For Future Solar Electric." The reserved space shall be at the opposite (load) end of the busbar from the primary energy source.

**R404.5.1.4 Electrical interconnection.** An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the solar-ready zone by a minimum 1 inch (25 mm) nonflexible metallic conduit or permanently installed wire as approved by the code official. Where the interconnection terminates in the attic, location shall be no less than 12 inches (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled "For Future Solar Electric".

**R404.5.2 Other Group R occupancies.** Other Group R occupancies shall comply with Section C405.14.

**R404.6 Electric Vehicle Power Transfer Infrastructure.** New automobile parking spaces for one- and two-family dwellings and townhouses shall be provided in accordance with Sections R404.6.1 through R404.6.5. New automobile parking spaces for R-2 occupancies shall comply with Section C405.13.

**R404.6.1 Quantity.** New one- and two-family dwellings and townhouses with a designated attached or detached garage or other onsite private parking provided adjacent to the dwelling unit shall be provided with one EV-capable, EV-ready, or EVSE installed space per dwelling unit. **R404.6.2 EV Capable Spaces.** Each EV capable space used to meet the requirements of Section R404.6.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 3 feet (914 mm) of the EV capable space and a suitable panelboard or other onsite electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with R404.7.4

3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future electric vehicle supply equipment (EVSE)."

**R404.6.3 EV Ready Spaces.** Each branch circuit serving EV ready spaces shall comply with all of the following:

1. Terminate at a receptacle outlet, located within 3 feet (914 mm) of each EV ready space it serves.
2. Have a minimum circuit capacity in accordance with R404.6.4.
3. The panelboard or other electrical distribution equipment directory shall designate the branch circuit as "For electric vehicle supply equipment (EVSE)" and the outlet or enclosure shall be marked "For electric vehicle supply equipment (EVSE)."

**R404.6.4 Circuit Capacity.** For one- and two-family dwellings and townhouses, the capacity of electrical infrastructure serving each EV capable space, EV ready space and EVSE space shall have a rated capacity not less than 8.3 kVA (or 40A at 208/240V) for each EV capable space, EV ready space or EVSE space it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70. **R404.6.5 EVSE installation.** For one- and two-family dwellings and townhouses, EVSE shall be installed in accordance with NFPA 70 and shall be listed and labeled in accordance with UL 2202 or UL 2594. **R404.6.5.1 EVSE minimum charging rate.** Each installed EVSE shall comply with one of the following:

1. Be capable of charging at a rate of not less than 6.2 kVA (or 30A at 208/240V).
2. Where serving EVSE spaces allowed to have a circuit capacity of not less than 2.7 kVA in accordance with R404.7.4.1 and controlled by an energy management system providing load management, be capable of simultaneously charging each EVSE space at a rate of not less than 2.1 kVA.

**R404.7 Electrical energy storage system ready.** One- and two-family dwellings and townhouses shall be energy storage ready in accordance with Sections R404.7.1 through R404.7.4. Other Group R occupancies shall comply with Section C405.15.

**Exception:** One- and two-family dwellings and townhouses with an installed *Energy Storage System (ESS)* with a minimum rated energy capacity of 5 kWh with a minimum of four ESS supplied branch circuits complying with RD103.3.4.

**R404.7.1 Energy storage system space.** Interior or exterior space with dimensions and locations in accordance with Section 1207 of the *International Fire Code* and Section 110.26 of NFPA 70 shall be reserved to allow for the future installation of an energy storage system.

**R404.7.2 System Isolation Equipment Space.** Space shall be reserved to allow for the future installation of a transfer switch within 3 feet (305mm) of the main panelboard. Raceways shall be installed between the panelboard and the transfer switch location to allow the connection of an ESS.

**R404.7.3 Panelboard with backed-up load circuits.** A dedicated raceway from the main service to a panelboard that supplies the branch circuits served by the ESS. All branch circuits are permitted to be supplied by the main service panel prior to the installation of an ESS. The trade size of the raceway shall be not less than one inch. The panelboard that supplies the branch circuits shall be labeled "Subpanel reserved for future battery energy storage system to supply essential loads."

**R404.7.4 Branch circuits served by ESS.** A minimum of four branch circuits shall be identified and have their source of supply collocated at a single panelboard supplied by the ESS. The following end uses shall be served by the branch circuits:

1. A refrigerator.
2. One lighting circuit near the primary egress.
3. A receptacle outlet.

**R404.8 Inverters.** Direct-current-to-alternating-current inverters serving on-site renewable energy systems or on-site electrical energy storage systems shall be compliant with IEEE 1547-2018a and UL 1741-2021.

## SECTION R405 TOTAL BUILDING PERFORMANCE

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

**R405.2 Performance-based compliance.** Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total building thermal envelope UA, which is the sum of the U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.23.
3. An annual energy cost of the proposed design that is less than or equal to 77 percent of the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration’s State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of- use pricing in energy cost calculations.

**Exception:** The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

**R405.3 Documentation.** Documentation of the software used for the proposed design and the parameters for the baseline *building* shall be in accordance with Sections R405.3.1 through R405.3.2.2.

**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 R405.2. 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 confirmed condition of the building shall be submitted to the *code official* before a certificate of occupancy is issued.

Compliance reports shall include information in accordance with Sections R405.3.2.1 and R405.3.2.2.

**TABLE R405.2  
REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE**

SECTION <sup>a</sup>	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and door insulation installation and retention
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration <i>U</i> -factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation



R403.7	Packaged and split system cooling equipment
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Roof and gutter deicing controls
R403.11	Freeze protection system controls
R403.12	Energy consumption of pools and spas
R403.13	Portable spas
R403.14	Residential pools and permanent residential spas
R403.15	Heating outside a building
R403.16	Cooling outside a building
R404	Electrical power, lighting, storage, and renewable energy systems
R407	Maintenance information and system commissioning
R409	Energy reporting and metering

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

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

1. Building street address, or other *building site* identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. A certificate indicating that the proposed design complies 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.
6. Where 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 the following:

1. Building street address, or other building site identification.
2. Declaration of the simulated building performance path on the title page of the energy report and the title page of the building plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.2.
4. The name and version of the compliance software tool.
5. A site-specific energy analysis report that is in compliance with Section R405.2.
6. 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. When on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

**R405.4 Calculation procedure.** Calculations of the proposed design shall be in accordance with Sections R405.4.1 and R405.4.2.

**R405.4.1 General.** Except as specified by this section, the *standard reference design* and *proposed design* shall be configured and analyzed using identical methods and techniques.

**R405.4.2 Residence specifications.** The *standard reference design* and *proposed design* shall be configured and analyzed as specified by Table R405.4.2(1). Table R405.4.2(1) shall include, by reference, all notes contained in Table R402.1.3.

**TABLE R405.4.2(1)**  
**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise, wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	<i>U</i> -factor: as specified in Table R402.1.2.	As proposed
	Solar absorptance = 0.75.	As proposed
	Emittance = 0.90.	As proposed
Basement and crawl space walls	Type: same as proposed.	As proposed
	Gross area: same as proposed.	As proposed
	<i>U</i> -factor: as specified in Table R402.1.2, with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	<i>U</i> -factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	<i>U</i> -factor: as specified in Table R402.1.2.	As proposed
Roofs	Type: composition shingle on wood sheathing.	As proposed
	Gross area: same as proposed.	As proposed
	Solar absorptance = 0.75.	As proposed
	Emittance = 0.90.	As proposed
Attics	Type: vented with an aperture of 1 ft <sup>2</sup> per 300 ft <sup>2</sup> of ceiling area.	As proposed
Foundations	Type: same as proposed.	As proposed
	Foundation wall area above and below grade and soil characteristics: same as proposed.	As proposed
Opaque doors	Area: 40 ft <sup>2</sup> .	As proposed
	Orientation: North.	As proposed
	<i>U</i> -factor: same as fenestration as specified in Table R402.1.2.	As proposed

Vertical fenestration other than opaque doors	Total area <sup>h</sup> = The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area. 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: $0.92 - (0.21 \times \text{SHGC for the standard reference design})$ .	Interior shade fraction: $0.92 - (0.21 \times \text{SHGC as proposed})$
	External shading: none	As proposed

(continued)

**TABLE R405.4.2(1)—continued**  
**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour.	The measured air exchange rate. <sup>a</sup>
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: $CFA$ = conditioned floor area, ft <sup>2</sup> . $N_{br}$ = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	The mechanical ventilation rate <sup>b</sup> shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal $(1/e_f) \times [0.0876 \times CFA + 65.7 \times (N_{br} + 1)]$ where: $e_f$ = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ $CFA$ = conditioned floor area, ft <sup>2</sup> . $N_{br}$ = number of bedrooms.	As proposed

Internal gains	IGain, in units of Btu/day per dwelling unit, shall equal $17,900 + 23.8 \times CFA + 4,104 \times N_{br}$ where: $CFA$ = conditioned floor area, ft <sup>2</sup> . $N_{br}$ = number of bedrooms.	Same as standard reference design.
Internal mass	Internal mass for furniture and contents: 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	For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.	As proposed
	For other walls, ceilings, floors, and interior walls: wood frame construction.	As proposed
Heating systems <sup>d, e</sup>	For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.7.	As proposed
Cooling systems <sup>d, f</sup>	As proposed. Capacity: sized in accordance with Section R403.7.	As proposed

(continued)

**TABLE R405.4.2(1)—continued**  
**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN		
Service water heating <sup>d, g</sup>	As proposed. Use, in units of gal/day = $25.5 + (8.5 \times N_{br})$ where: $N_{br}$ = number of bedrooms.	As proposed Use, in units of gal/day = $25.5 + (8.5 \times N_{br}) \times (1 - HWDS)$ where: $N_{br}$ = number of bedrooms. $HWDS$ = factor for the compactness of the hot water distribution system.		
		Compactness ratio <sup>i</sup> factor		HWDS
		1 story	2 or more stories	
		> 60%	> 30%	0
		> 30% to ≤ 60%	> 15% to ≤ 30%	0.05
		> 15% to ≤ 30%	> 7.5% to ≤ 15%	0.10
		< 15%	< 7.5%	0.15

Thermal distribution systems	<p>Duct insulation: in accordance with Section R403.3.1.</p> <p>A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems.</p> <p>Duct location: same as proposed design.</p> <p><b>Exception:</b> For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft<sup>2</sup> (9.29 m<sup>2</sup>) of conditioned floor area at a pressure of differential of 0.1 inch w.g. (25 Pa).</p>	<p>Duct location: as proposed</p> <p>Duct insulation: as proposed.</p> <p>As tested or, where not tested, as specified in Table R405.4.2(2).</p>
Thermostat	<p>Type: Manual, cooling temperature setpoint = 75°F;</p> <p>Heating temperature setpoint = 72°F.</p>	Same as standard reference design.
Dehumidistat	<p>Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design:</p> <p>None.</p> <p>Where the proposed design utilizes a mechanical ventilation system with latent heat recovery:</p> <p>Dehumidistat type: manual, setpoint = 60% relative humidity.</p> <p>Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.</p>	Same as standard reference design.

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 (US) = 3.785 L, °C = (°F-32)/1.8, 1 degree =

0.79 rad.

- a. 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.
- b. 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.
- c. Thermal storage element shall mean a component that is 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 shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.
- d. 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.
- e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
- f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
- g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having 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.

(continued)

**TABLE R405.4.2(1)—continued**  
**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

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

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

where:

$AF$  = Total glazing area.

$A_s$  = Standard reference design total glazing area.

$FA$  = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

$F = (\text{above-grade thermal boundary wall area}) / (\text{above-grade thermal boundary wall area} + \text{common wall area})$  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.

- 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 multiple-family 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 R405.4.2(2)**  
**DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS<sup>a</sup>**

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS <sup>b</sup>
Distribution system components located in unconditioned space	—	0.95
Untested distribution systems entirely located in conditioned space <sup>c</sup>	0.88	1
“Ductless” systems <sup>d</sup>	1	—

- a. Default values in this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.
- b. Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.
- c. 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.
- d. Ductless 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.

**R405.5 Calculation software tools.** Calculation software, where used, shall be in accordance with Sections R405.5.1 through R405.5.3.

**R405.5.1 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. Computer generation of the *standard reference design* using only the input for the *proposed design*. The calculation procedure shall not allow the user to directly modify the building component characteristics of the *standard reference design*.
- 2. 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 R403.7.
- 3. 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.
- 4. Printed *code official* inspection checklist listing each of the *proposed design* component characteristics from Table R405.4.2(1) determined by the analysis to provide compliance, along with their respective performance ratings such as *R*-value, *U*-factor, SHGC, HSPF, AFUE, SEER and EF.

**R405.5.2 Specific approval.** Performance analysis tools meeting the applicable provisions 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 such tools for a specified application or limited scope.

**R405.5.3 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  
ENERGY RATING INDEX COMPLIANCE ALTERNATIVE**

**R406.1 Scope.** This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis.

**R406.2 ERI compliance.** Compliance based on the ERI requires that the rated design meets all of the following:

1. The requirements of the sections indicated within Table R406.2.
2. Maximum ERI of Table R406.5.

**TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX**

SECTION <sup>a</sup>	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and door insulation installation and retention
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Packaged and split system cooling equipment
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Roof and gutter deicing controls
R403.11	Freeze protection system controls
R403.12	Energy consumption of pools and spas
R403.13	Portable spas
R403.14	Residential pools and permanent residential spas
R403.15	Heating outside a building
R403.16	Cooling outside a building

R404	Electrical power, lighting, storage, and renewable energy systems
R406.3	Building thermal envelope
R407	Maintenance information and system commissioning
R409	Energy reporting and metering

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

**R406.3 Building thermal envelope.** Building and portions thereof shall comply with Section R406.3.1 or R406.3.2.

**R406.3.1 On-site renewables are not included.** Using the ERI analysis of Section R406.4, the proposed total building thermal envelope UA, which is sum of *U*- factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive *U*-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30. On-site renewables shall not be included in the ERI analysis.

$$UA_{\text{Proposed design}} \leq 1.15 \times UA_{\text{Prescriptive reference design}}$$

**(Equation 4-1)**

**R406.4 Energy Rating Index.** The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301 the ERI reference design ventilation rate shall be in accordance with the *International Mechanical Code* Equation 4-2.

Ventilation rate, CFM = (0.01 × total square foot area of house) + [7.5 × (number of bedrooms + 1)]

**(Equation 4-2)**

Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the *ERI reference design* or the *rated design*. For compliance purposes, any reduction in energy use of the rated design associated with on-site renewable energy shall not exceed 5 percent of the total energy use.

**R406.5 ERI-based compliance.** Compliance based on an ERI analysis requires that the *rated proposed design* and confirmed built dwelling be shown to have an ERI less than or equal to 53 without taking credit for any on-site renewables when compared to the *ERI reference design*.


**R406.6 Verification by approved agency.** Verification of compliance with Section R406 as outlined in Sections R406.4 and R406.6 shall be completed by an *approved* third party. Verification of compliance with Section R406.2 shall be completed by the authority having jurisdiction or an *approved* third-party inspection agency in accordance with Section R105.4.

**R406.7 Documentation.** Documentation of the software used to determine the ERI and the parameters for the *residential building* shall be in accordance with Sections R406.7.1 through R406.7.4.

**R406.7.1 Compliance software tools.** Software tools used for determining ERI shall be *Approved* Software Rating Tools in accordance with RESNET/ICC 301.

**R406.7.2 Compliance report.** Compliance software tools shall generate a report that documents that the home and the ERI score of the *rated design* complies with Sections R406.2, R406.3 and R406.4. Compliance documentation shall be created for the proposed design and shall be submitted with the application for the building permit. Confirmed compliance documents of the built *dwelling unit* shall be created and submitted to the code official for review before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R406.7.2.1 and R406.7.2.2.

**R406.7.2.1 Proposed compliance report for permit application.** Compliance reports submitted with the application for a building permit shall include the following:

1. Building street address, or other building site identification.
2. Declare ERI on title page and building plans.
3. The name of the individual performing the analysis and generating the compliance report.
4. The name and version of the compliance software tool.



5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A certificate indicating that the proposed design has an ERI less than or equal to the appropriate score indicated in Table R406.5 when compared to the ERI reference design. The certificate shall document the building component energy specifications that are included in the calculation, including: component level insulation R-values or U-factors; assumed duct system and building envelope air leakage testing results; 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.
7. 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.

**R406.7.2.2 Confirmed compliance report for a certificate of occupancy.** A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other building site identification.
2. Declaration of ERI on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A final confirmed certificate indicating that the confirmed rated design of the built home complies with Sections R406.2 and R406.4. 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. Where on-site renewable energy systems have been installed on or in the home, the certificate shall report the type and production size of the installed system.

**R406.7.4 Additional documentation.** The *code official* shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the ERI reference design.
2. A certification signed by the builder providing the building component characteristics of the rated design.
3. Documentation of the actual values used in the software calculations for the rated design.

**R406.7.5 Specific approval.** Performance analysis tools meeting the applicable subsections of Section R406 shall be *approved*. Documentation demonstrating the approval of performance analysis tools in accordance with Section R406.7.1 shall be provided.

**R406.7.6 Input values.** Where calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from RESNET/ICC 301.

## SECTION R407 MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING

**R407.1 Maintenance information and system commissioning.** Buildings shall comply with the IECC- Commercial Provisions, Section C408.

## SECTION R408 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

**R408.1 Scope.** This section establishes additional efficiency package options to achieve additional energy efficiency in accordance with Section R401.2.5.

**R408.2 Additional efficiency package options.** Additional efficiency package options for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.4.

**R408.2.1 Enhanced envelope option.** The total *building thermal envelope* UA, the sum of *U*-factor times assembly area, shall be less than or equal to 95 percent of the total UA resulting from multiplying the *U*-factors in Table R402.1.2 by the same assembly area as in the proposed building. The UA calculation shall be performed in accordance with Section R402.1.5. The area-weighted average SHGC of all glazed fenestration shall be less than or equal to 95 percent of the maximum glazed fenestration

SHGC in Table R402.1.2. **R408.2.3 More efficient HVAC equipment performance option.** Heating and cooling equipment shall meet one of the following efficiencies:

1. Greater than or equal to 96 AFUE natural gas furnace or boiler(s).
2. Greater than or equal to 8.5 HSPF2/16.0 SEER2 air source heat pump(s).
3. Greater than or equal to 9 HSPF (7.6 HSPF2) /16 SEER (15.2 SEER2) air source heat pump(s).
4. Greater than or equal to 10 HSPF (8.5 HSPF2) /16 SEER (15.2 SEER2) air source heat pump(s).
5. Greater than or equal to 3.5 COP ground source heat pump.

Ductless Systems:

6. Single Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump(s).
7. Multi Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump(s) (Non-Ducted Indoor Units).
8. Multi Zone: 8.5 HSPF2/15.2 SEER2 variable speed air source heat pump(s) (Ducted or Mixed Indoor Units)

**R408.2.4 Reduced energy use in service water-heating options.** The hot water system shall meet one of the Uniform Energy Factors (UEF) or Solar Uniform Energy Factors (SUEF): in Table R408.2.3.

**TABLE R408.2.3**  
**Service water-heating efficiencies**

Measure Number	Water Heater	Size and Draw Pattern	Type	Efficiency
R408.2.3(1)	Gas-fired storage water heaters	≤ 55 gallons, Medium		UEF ≥0.81
		≤ 55 gallons, High		UEF ≥0.86
		>55 gallons, Medium or High		UEF ≥0.86
R408.2.3(2)	Gas-fired instantaneous water heaters	Medium or High		UEF ≥0.95
R408.2.3(3)	Electric water heaters	Low, Medium, or High	Integrated HPWH	UEF ≥ 3.30
R408.2.3(4)			Integrated HPWH, 120 Volt/15 Amp Circuit	UEF ≥ 2.20
R408.2.3(5)	Solar water heaters		Electric backup	SUEF ≥ 3.00
			Gas backup	SUEF ≥ 1.80

**R408.2.5 More efficient duct thermal distribution system option.** The thermal distribution system shall meet one of the following efficiencies:

1. 100 percent of ducts and air handlers located entirely within the *building thermal envelope*.
2. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the *building thermal envelope*.
3. 100 percent of duct thermal distribution system located in *conditioned space* as defined by Section R403.3.2.

### SECTION R409 ENERGY REPORTING AND METERING

**R409.1 Energy Reporting Requirements:** Dwellings shall be subject to Section 8.60 – Building IQ of the Aspen Municipal Code and shall follow the requirements for a “Non-City Covered Property.” Buildings shall comply with the requirements of the Multi-Family Residential structures over 15,000 square feet. This requirement shall supersede the applicability statements in Section 8.60.030 and the exceptions listed in Section 8.60.020, as amended.

**R409.2 Energy Metering.** Each dwelling unit shall have separate electric and water meters. Where gas is installed to the building, each dwelling unit shall have a separate gas meter.

## CHAPTER 5 [RE]

# EXISTING BUILDINGS

### User note:

**About this chapter:** Many buildings are renovated or altered in numerous ways that could affect the energy use of the building as a whole. Chapter 5 requires the application of certain parts of Chapter 4 in order to maintain, if not improve, the conservation of energy by the renovated or altered building.

### 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.

**R501.1.1 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.

**R501.2 Compliance.** *Additions, alterations, repairs* or changes of occupancy to, or relocation of, an existing *building, building* system or portion thereof shall comply with Section R502, R503, R504 or R505, respectively, in this code. Changes where unconditioned space is changed to *conditioned space* shall comply with Section R501.7.

**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 to the code edition under which installed. The owner or the owner's authorized agent shall be responsible for the maintenance of *buildings* and structures. The requirements of this chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection and safety systems and devices in existing structures.

**R501.4 Compliance.** *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 Building Code, International Existing Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, International Plumbing 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 that hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not allow their use in *buildings* of similar occupancy, purpose and location.

**R501.6 Historic buildings.** Provisions of this code relating to the construction, *repair, alteration,* restoration and movement of structures, and *change of occupancy* shall not be mandatory for *historic buildings* provided that a report has been submitted to the code official and signed by the owner, a *registered design professional,* or a representative of the State Historic Preservation Office or the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic form, fabric or function of the *building.*

**R501.7 Change in space conditioning.** Any unconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

**Exception:** Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.2.

**R501.8 Energy Assessment.** When required by R502.3.6 or R503.1.6, existing buildings shall submit an *Energy Assessment Report* at permit submittal. The energy assessment recommendations and/or conclusions may inform but are not required to affect the scope of the work submitted for permit.

**Exception:** For *additions* and *alterations* where the *Energy Assessment Report* indicates the air infiltration rate in a dwelling unit is less than 5 air changes per hour, ventilation shall be provided in accordance with Section R503.1.1.6.1.

### 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. *Additions* shall not create an unsafe or hazardous condition or overload existing *building* systems. **R502.3 Prescriptive compliance.** *Additions* shall comply with Sections R502.3.1 through R502.3.6.

**R502.3.1 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:** New envelope assemblies are exempt from the air leakage requirements of Sections R402.4.1.3 and R402.4.1.4 but must comply with Section R503.1.1.6.1 Testing and Ventilation.

**R502.3.2 Heating and cooling systems.** HVAC ducts newly installed as part of an *addition* shall comply with Section R403.

**Exception:** Where ducts from an existing heating and cooling system are extended into an *addition* Section R403.3.5 and Section R403.3.6 shall not be required.

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

**R502.3.4 Lighting and power.** *Additions* shall comply with this section. New lighting and power systems that are part of the *addition* shall comply with Section R404.

**R502.3.4.1 Renewable energy infrastructure.** Additions shall comply with the requirements of Section R404.5.

**Exception:** Additions where the new roof area is less than less than 500 square feet of roof area oriented between 110 degrees and 270 degrees of true north.

**R502.3.4.2 Electric vehicle charging infrastructure.** New parking facilities, new parking spaces added to existing parking facilities and new attached and detached garages shall comply with Section R404.6.

**R502.3.4.3 Energy storage infrastructure.** Additions with new attached or detached garages shall comply with Section R404.7.

**R502.3.5 Energy Assessment.** Additions shall comply with section R501.8.

**R502.3.6 Energy Reporting.** Additions shall comply with section R409.1.

## 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 not less conforming to the provisions of this code than the existing *building* or structure was prior to the *alteration*.

*Alterations* shall not create an unsafe or hazardous condition or overload *existing* building systems. *Alterations* shall be such that the existing *building* or structure does not use more energy than the existing building or structure prior to the *alteration*. *Alterations* to existing *buildings* shall comply with Sections R503.1.1 through R503.1.6.

Level 4 *alterations* apply where the *work area* exceeds 50 percent of the *dwelling unit building area*.

**R503.1.1 Building thermal envelope.** Alterations of existing building thermal envelope assemblies shall comply with this section. New building thermal envelope assemblies that are part of the *alteration* shall comply with Section R402. An area-weighted average U-factor for new and altered portions of the building thermal envelope shall be permitted to satisfy the U-factor requirements in Table R402.1.2. In no case shall the R-value of insulation be reduced, or the U-factor of a building thermal envelope assembly be increased as part of a building thermal envelope alteration.

**Exception:** The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. *Roof recover*
3. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.
4. An existing building undergoing alterations that is demonstrated to be in compliance with Section R405 or Section R406

**R503.1.1.1 Fenestration alterations.** Where new fenestration area is added to an existing building, the new fenestration shall comply with Section R402.3. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and SHGC as specified in Table R402.1.3. Where more than one replacement fenestration unit is to be installed, an area-weighted average of the *U*-factor, SHGC or both of all replacement fenestration units shall be an alternative that can be used to show compliance.

**Exception:** Where the existing building exceeds the fenestration area limitations of Section R402.3.6 prior to alteration, the building is exempt from Section R402.3.6 provided that there is not an increase in fenestration area.

**R503.1.1.2 Roof alterations.** Roof alterations shall comply with this section.

**R503.1.1.2.1 Roof insulation.** Roof insulation complying with Section R402.1 or an *approved* design that minimizes deviation from the insulation requirements, shall be provided for the following roof alterations:

1. An alteration to roof-ceiling construction where there is no insulation above conditioned space,
2. Roof replacement for roofs with insulation above deck,
3. Conversion of unconditioned attic space into conditioned space,
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction to which insulation can be applied.

Roofs not constructed to currently adopted snow loads shall provide a report by a registered design professional or other *approved* source documenting the structure is capable of supporting loads associated with any changes required by this section.

Where compliance with Section R402.1 cannot be met due to limiting conditions on an existing roof, the following shall be permitted to demonstrate compliance with the insulation requirements:

1. Construction documents that include a report by a registered design professional or other approved source documenting details of the limiting conditions affecting compliance with the insulation requirements.
2. Construction documents that include a roof design by a registered design professional or other approved source that minimizes deviation from the insulation requirements.

**R503.1.1.2.2 Roof and gutter deicing controls.** *Roof recover* and *roof replacement* alterations with existing or new roof and gutter deicing systems shall have controls installed complying with R403.10.

1. **R503.1.3 Above-grade wall alterations.** Above-grade wall alterations shall comply with the following requirements as applicable: Where wall cavities are exposed, the cavity shall be filled with cavity insulation complying with Section R303.1.4 and Section R303.2. New cavities created shall be insulated in accordance with Section R402.1 or an approved design that minimizes deviation from the insulation requirements.
2. Where wall cavities are exposed in Level 4 alterations, the cavity shall be insulated in accordance with Section R402.1 or an approved design that minimizes deviation from the insulation requirements.
3. Where exterior wall coverings and fenestration are added or replaced for the full extent of any exterior wall assembly on one or more elevations of the building, insulation shall be provided where required in accordance with one of the following:
  - 1.1. An R-value of continuous insulation not less than that designated in Table R402.1.3 for the applicable above-grade wall type and existing cavity insulation R-value, if any;
  - 3.2 An R-value of not less than that required to bring the above-grade wall into compliance with Table R402.1.3; or,
  - 3.3 An approved design that minimizes deviation from the insulation requirements of Section R402.1.
4. Where Items 1 and 2 apply, insulation shall be provided in accordance with Section R402.1 using the values for new construction from Table R402.1.3 or an approved design that minimizes deviation from the insulation requirements.
5. Where new interior finishes or exterior wall coverings are applied to the full extent of any exterior wall assembly of mass construction, insulation shall be provided where required in accordance with Section R402.1 or an approved design that minimizes deviation from the insulation requirements.

Where any of the above requirements are applicable, the above-grade wall alteration shall comply with Sections 1402.2 and 1404.3 of the *International Building Code*.

**R503.1.1.4 Floor alterations.** Where an alteration to a floor or floor overhang exposes cavities or surfaces to which insulation can be applied, and the floor or floor overhang is part of the building thermal envelope, the floor or floor overhang shall be brought into compliance with Section R402.1 or an approved design that minimizes deviation from the insulation requirements. This requirement applies to floor alterations where the floor cavities or surfaces are exposed and accessible prior to construction.

**R503.1.1.5 Below-grade wall alterations.** Where unconditioned below-grade space is changed to conditioned space, walls enclosing such conditioned space shall be insulated where required in accordance with Section R402.1. Where the below-grade space is conditioned space and where walls enclosing such space are altered by removing or adding interior finishes, they shall be insulated where required in accordance with Section R402.1.

**R503.1.1.6 Air barrier.** Building thermal envelope assemblies altered in accordance with Section R503.1.1 shall be provided with an air barrier in accordance with Section R402.4.1.1. The air barrier shall be made continuous

with unaltered portions of the building thermal envelope to the extent feasible within the scope of work. Level 4 alterations shall comply with Section R503.1.1.6.1.

**R503.1.1.6.1 Testing and ventilation.** The dwelling unit shall be tested in accordance with Section R402.4.1.2. Where the air infiltration rate is less than 5 air changes per hour, the dwelling unit shall be provided with mechanical ventilation in accordance with Section 403.3.2 of the *International Mechanical Code* or with other *approved* means of ventilation and shall be tested in accordance with Section R403.6.3.

**Exception:** An outdoor air ventilation system consisting of a mechanical exhaust system, supply system or combination thereof shall be permitted. Local exhaust or supply systems, including outdoor air ducts connected to the return side of an air handler, are permitted to serve as such a system. Ventilation rate shall be in accordance with Section 403.3.2 of the *International Mechanical Code*. System shall be tested in accordance with Section R403.6.3.

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

**Exception:** Where ducts from an existing heating and cooling system are extended to an *addition*.

**R503.1.2.1 Controls** New heating and cooling equipment that are part of the alteration shall comply with Section R403.1.

**R503.1.2.2 Mechanical system acceptance testing.** Where an alteration requires compliance with Section R403 or any of its subsections, mechanical systems that serve the alteration shall comply with IECC- Commercial Provisions, Section C408.2.

**Exception:** Heating and cooling equipment that serve multiple dwelling units when alterations are made to a single dwelling unit.

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

**R503.1.3.1 Service hot water system acceptance testing.** Where an alteration requires compliance with Section R403.5 or any of its subsections, service hot water systems that serve the alteration shall comply with IECC – Commercial Provisions, Section C408.2.

**Exception:** Where alterations are made to a single dwelling unit where the service water heating equipment serves multiple dwelling units.

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

**R503.1.4.1 Electrical Service replacement.** Where a building electrical service is replaced, the new electrical service shall include electrical capacity sized in accordance with the NEC (NFPA 70) for the following future branch circuits:

1. Replacement of all currently installed combustion equipment used for cooking with electric cooking appliances in accordance with Section R404.4.1.
2. Replacement of all currently installed combustion equipment used for clothes drying with electric clothes dryers in accordance with Section R404.4.2.
3. Renewable energy infrastructure in accordance with Section R404.5.
4. Electric vehicle charging infrastructure in accordance with Section R404.6.
5. Energy storage infrastructure in accordance with Section R404.7.
6. Replacement of all currently installed combustion lighting with electric lighting.

**Exception:** Where there is not adequate transformer capacity or other infeasibility exists and approved by the Code Official.

**R503.1.4.2 Electric vehicle charging infrastructure.** Alterations shall be provided with electric vehicle charging infrastructure in accordance with this section.

**R503.1.4.2.1 One- and two-family dwellings and townhouses.** An alteration of a one- and two-family dwelling or townhouse shall meet the requirements of Section R404.6 where alteration work in a garage or adjacent to an on-site parking space includes the installation of a new branch circuit.

**R503.1.4.2.2 R-2 occupancies.** Alterations to existing parking facilities in R-2 occupancies shall comply IECC Commercial Provisions, Section C503.5.3.

**R503.1.5 Energy Assessment.** Level 4 *alterations* shall comply with section R501.8.

**R503.1.6 Energy Reporting.** Level 4 *alterations* shall comply with section R409.1.

### **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 necessary for the required *repair* of damaged components shall be considered to be part of the *repair* and shall not be subject to the requirements for *alterations* in this chapter. Routine maintenance required by Section R501.3, ordinary repairs exempt from *permit*, and abatement of wear due to normal service conditions shall not be subject to the requirements for *repairs* in this section.

**R504.2 Application.** For the purposes of this code, the following shall be considered to be *repairs*:

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

### **SECTION R505 CHANGE OF OCCUPANCY OR USE**

**R505.1 General.** Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this code.

**Exception:** Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost allowed by Section R405.2.

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

## APPENDIX RD: Renewable Energy Mitigation Program (REMP)

### User note:

**About this appendix:** Appendix RD is intended to reduce amenity energy use and offset it through the installation of on-site renewable energy systems.

**RD101 Scope.** These provisions shall be applicable to specific exterior and interior energy uses and on-site energy production and energy efficient technologies used to offset those energy uses. Compliance with this section will be documented via the free Public Domain tool “City of Aspen REMP Calculation Sheet” in the most current version at the time of permit application. This tool is available at [www.aspen.gov](http://www.aspen.gov). Projected energy use associated energy offset required, requirements for those uses and offsets, fees, and credits are defined within this tool.

**RD102 Exterior Energy Uses.** Residential and Commercial exterior energy uses (per list below) may be installed only if they meet the requirements of this appendix and the requirements in sections R403 and C403 as applicable. This applies to all installations for which an application for a permit or renewal of an existing permit is filed or is by law required to be filed with or without an associated Building Permit.

1. Snowmelt (ie: driveways, patios, walkways, etc.), including electric heat mats and hydronic roof and gutter deicing systems

**Exception:** Areas critical for access and emergency egress as approved by the building official and including:

- a. A nine square foot portion of emergency escape and rescue window wells.
- b. Accessible routes as defined by IBC section 1104.1 and 1104.2 and limited to 48” in width.
- c. Sidewalks serving buildings or portions of buildings that are not *residential buildings* in the City Right of Way limited to 48” in width

2. Exterior pools

3. Exterior permanent and portable spas

**Exception:** A maximum of (1) portable spa per property with a water surface area of not more than 64 square feet is exempt.

4. Electric heat tape including roof and gutter deicing systems and exterior piping.

**Exception:** 1000 watts are exempt.

5. Exterior heaters

6. Exterior gas fireplaces and firepits

**RD102.1 Residential Exterior Energy Use Budget.** The total aggregate annual energy use of all exterior energy uses listed in Section RD102 shall be limited to 200,000,000 btu per *building site*. This energy use may be distributed among the types of regulated energy uses at the discretion of the applicant.

### Exceptions:

1. Energy uses exempted by Section RD102
2. Energy uses serving buildings or portions of buildings that are not *residential buildings*.

**RD103 Interior Energy Uses.** Residential and Commercial interior energy uses (per list below) may be installed only if the supplemental energy meets the requirements of this appendix and the requirements in sections R403 and C403 as applicable. This applies to all installations for which an application for a permit or renewal of an existing permit is filed or is by law required to be filed with or without an associated Building Permit.

1. Interior gas fireplaces

**RD106 REMP Payment Option.** The RREMP payment option is the difference in energy use and on-site renewable credits calculated by the “City of Aspen REMP Calculation Sheet” and shall be paid at the time of issuance of the building permit. No refund of payment shall be made to an applicant for installation of renewable energy production that exceeds the on-site renewable credits required pursuant to Appendix A. All monies collected pursuant to this section shall be recorded in a separate fund by the City Finance Director and shall be spent in accordance with a joint resolution by the Aspen City Council and Pitkin County Board of County Commissioners.

**RD102 Credits for on-site renewable energy.** This REMP payment option is voluntary. Applicants interested in exterior energy use systems can alternatively choose to produce on-site renewable energy or use energy efficient technologies to offset energy uses regulated by this appendix in accordance with Section RD105 and as calculated by



the “City of Aspen REMP Calculation Sheet”.

**RD103 Pre-Existing Systems.** Pre-existing systems, for which a prior REMP fee was paid, regulated by the scope of this section sought to be replaced by an Applicant, shall receive a pro-rated credit calculated as a fraction of the number of years since prior REMP payment for the system divided by 20 years. For example, a REMP payment made for a system permitted 10 years prior to the current replacement permit submittal would receive credit for ½ of the prior REMP payment and that amount shall be deducted from REMP payment owed for replacement system. For renewable systems installed on site, full credit will be given for up to 20 years after the date of installation. Credits will only be applied to properly permitted and functioning systems within the scope of the adopted Energy Code and applicable Mechanical and Electrical Codes. Systems installed prior to 20 years before the date of permit application are not eligible for pro-ration of system credits.

Upgrades to existing mechanical equipment (boilers, heat pumps, HVAC equipment, etc.) or renewables energy systems will not require a re-submittal to the application program. However, additions to or replacement of exterior or interior energy uses (as listed above in Section RD102) will require re-submittal of the appropriate REMP compliance documents. Additions to or replacement of exterior energy uses will be subject to the exterior energy use budget (Section RD102.1) which will apply to all existing exterior energy uses in aggregate. Previously permitted existing exterior energy use systems exceeding the exterior energy use budget may remain in existence provided there is no alteration or addition to exterior energy use.

**RD104 Repairs.** Repairs to building components, systems, or equipment which do not increase their pre-existing energy consumption need not comply with REMP.

**RD105 Onsite Renewable Credit Options** On-site renewable energy and energy efficient technologies available for credit are listed in Sections RD105.1 through RD105.5 and shall comply with those sections as applicable.

**RD105.1 Solar Photovoltaic System.** System designer/installer must be certified by COSEIA (Colorado Solar Energy Industries Association) or NABCEP, (North American Board of Certified Energy Practitioners), or a licensed Professional Engineer in the State of Colorado.

**RD105.2 Solar Hot Water.** The size of solar hot water systems is limited to 500 square feet of collector area absent approval by the Building Official. Systems larger than this limit will be considered but will require documentation showing year-round utilization of this larger system.

**RD105.3 Ground Source Heat Pump (GSHP).** Each ground source heat pump system shall be tested and balanced and commissioned in accordance with R407. The design engineer shall certify in writing that it meets or exceeds the design coefficient of performance (COP) as specified in the “City of Aspen REMP Calculation Sheet.”

The ground loop system must be designed by a CGD (Certified GeoExchange Designer certified by the Association of Energy Engineers) or a Professional Engineer licensed in the State of Colorado or an IGSHPA (International Ground Source Heat Pump Association) certified designer. The mechanical system must be installed by a certified IGSHPA contractor.

**RD105.4 Air Source Heat Pump (ASHP).** Each air source heat pump system shall be tested and balanced and commissioned in accordance with R407. The design engineer shall certify in writing that it meets or exceeds the design coefficient of performance (COP) as specified in the “City of Aspen REMP Calculation Sheet.”

**RD105.5 Alternative Energy Source.** *Approved* alternative energy sources designed and installed in accordance with generally accepted engineering practice by an *approved third party*.

**RD106 Energy Consumption Reporting.** *Residential buildings* shall comply with Section R409.1. All other buildings shall comply with Section C405.12.9.

## CHAPTER 6 [RE]

# REFERENCED STANDARDS

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**User note:**

**About this chapter:** This code contains numerous references to standards promulgated by other organizations that are used to provide requirements for materials and methods of construction. Chapter 6 contains a comprehensive list of all standards that are referenced in this code. These standards, in essence, are part of this code to the extent of the reference to the standard.

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 R108.

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## AAMA

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

**AAMA/WDMA/CSA 101/LS.2/A C440—17: North American Fenestration Standard/Specifications for Windows, Doors and Unit Skylights**

R402.4.3

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## ACCA

Air Conditioning Contractors of America  
1330 Braddock Place, Suite 350  
Alexandria, VA 22314

**ANSI/ACCA 2 Manual J—16: Residential Load Calculation**

R403.7

**ANSI/ACCA 3 Manual S—14: Residential Equipment Selection**

R403.7

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## APSP

Pool & Tub Alliance (formerly the APSP)  
2111 Eisenhower Avenue, Suite 500  
Alexandria, VA 22314

**ANSI/APSP/ICC 14—2019: American National Standard for Portable Electric Spa Energy Efficiency**

R403.11

**ANSI/APSP/ICC 15a—2011: American National Standard for Residential Swimming Pool and Spas—Includes Addenda A**

Approved January 9, 2013

R403.12

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## ASHRAE

ASHRAE  
180 Technology Parkway NW  
Peachtree Corners, GA 30092

**ASHRAE 193—2010(RA 2014): Method of Test for Determining the Airtightness of HVAC Equipment**

R403.3.4.1

**ASHRAE—2001: 2001 ASHRAE Handbook of Fundamentals**

Table R405.5.2(1)

**ASHRAE—2021: ASHRAE Handbook of Fundamentals**

R402.1.5

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**REFERENCED STANDARDS**


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**ASTM**

ASTM International  
100 Barr Harbor Drive, P.O. Box C700  
West Conshohocken, PA 19428-2959

**C1363—11: Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus**

R303.1.4.1

**E283—2004(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

**E779—2010(2018): Standard Test Method for Determining Air Leakage Rate by Fan Pressurization**

R402.4.1.2

**E1554/E1554M—E2013: Standard Test Methods for Determining Air Leakage of Air Distribution Systems by Fan Pressurization**

R403.3.5

**E1827—: 2011(2017): Standard Test Methods for Determining Airtightness of Building Using an Orifice Blower Door**

R402.4.1.2

**E2178—2013: Standard Test Method for Air Permanence of Building Materials**

R303.1.5

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**CSA**

CSA Group  
8501 East Pleasant Valley Road  
Cleveland, OH 44131-5516

**AAMA/WDMA/CSA 101/LS.2/A440—17: North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights**

R402.4.3

**CSA B55.1—2015: Test Method for Measuring Efficiency and Pressure Loss of Drain Water Heat Recovery Units**

R403.5.3

**CSA B55.2—2015: Drain Water Heat Recovery Units**

R403.5.3

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**DASMA**

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

**105—2017: Test Method for Thermal Transmittance and Air Infiltration of Garage Doors and Rolling Doors**

R303.1.3

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**HVI**

Home Ventilating Institute  
1740 Dell Range Blvd, Ste H, PMB 450  
Cheyenne, WY 82009

**916—18: Airflow Test Procedure**

Table R403.6.2

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**ICC**

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

**ANSI/APSP/ICC 14—2019: American National Standard for Portable Electric Spa Energy Efficiency**

R403.11

**ANSI/APSP/ICC 15a—2020: American National Standard for Residential Swimming Pool and Spa Energy Efficiency**

R403.12

**ANSI/RESNET/ICC 301—2019: Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index**

R406.4

**ICC—continued**

**ANSI/RESNET/ICC 380—2019: Standard for Testing Airtightness of Building, Dwelling Unit and Sleeping Unit Enclosures; Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems**

R402.4.1.2

**IBC—21: International Building Code®**

R201.3, R303.1.1, R303.2, R402.1.1, R501.4

**ICC 400—17: Standard on the Design and Construction of Log Structures**

R402.1

**ICC 500—2020: ICC/NSSA Standard for the Design and Construction of Storm Shelters**

R402.5

**IEBC—21: International Existing Building Code®**

R501.4

**IECC—06: 2006 International Energy Conservation Code®**

R202

**IECC—09: 2009 International Energy Conservation Code®**

R406.2

**IECC—15: 2015 International Energy Conservation Code®**

Table R406.5

**IFC—21: International Fire Code®**

R201.3, R501.4

**IFGC—21: International Fuel Gas Code®**

R201.3, R501.4

**IMC—21: International Mechanical Code®**

R201.3, R403.3.3, R403.3.4, R403.6, R501.4

**IPC—21: International Plumbing Code®**

R201.3, R501.4

**IPMC—21: International Property Maintenance Code®**

R501.4

**IPSDC—21: International Private Sewage Disposal Code®**

R501.4

**IRC—21: International Residential Code®**

R201.3, R303.1.1, R303.2, R402.1.1, R402.2.10.1, R403.3.3, R403.3.4, R403.6, R501.4

**IEEE**

Institute of Electrical and Electronics Engineers, Inc.  
3 Park Avenue, 17th Floor  
New York, NY 10016-5997

**515.1—2012: IEEE Standard for the Testing, Design, Installation and Maintenance of Electrical Resistance Trace Heating for Commercial Applications**

R403.5.1.2

**NFPA**

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

**70—20: National Electrical Code**

R501.4

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**REFERENCED STANDARDS**


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**NFRC**

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

**100—2020: Procedure for Determining Fenestration Products *U*-factors**  
R303.1.3

**200—2020: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence**  
R303.1.3

**400—2020: Procedure for Determining Fenestration Product Air Leakage**  
R402.4.3

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**RESNET**

Residential Energy Services Network, Inc.  
P.O. Box 4561  
Oceanside, CA 92052-4561

**ANSI/RESNET/ICC 301—2019: Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index**  
R406.4, R406.7.1, R406.7.6

**ANSI/RESNET/ICC 380—2019: Standard for Testing Airtightness of Building, Dwelling Unit and Sleeping Unit Enclosures; Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems**  
R402.4.1.2, R403.3.5

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**UL**

UL LLC  
333 Pfingsten Road  
Northbrook, IL 60062

**127—2011: Standard for Factory-Built Fireplaces—with Revisions through July 2016**  
R402.4.2

**515—2015: Standard for Electrical Resistance Trace Heating for Commercial Applications**  
R403.5.1.2

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**US-FTC**

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

**CFR Title 16 (2015): R-value Rule**  
R303.1.4

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**WDMA**

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

**AAMA/WDMA/CSA 101/I.S.2/A440—17: North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights**  
R402.4.3