DENVER GREEN CODE

CHAPTER 1

SCOPE AND ADMINISTRATION

PART 1—SCOPE AND APPLICATION

SECTION 101 GENERAL

101.1 Title. These regulations shall be known as the Denver Green Code hereinafter referred to as "this code."

101.2 (1.) Purpose.

101.2.1 (1.1) The purpose of this code is to provide minimum requirements for the siting, design, construction, and plans for operation of *high-performance green buildings* to: reduce emissions from buildings and building systems; enhance building occupant health and comfort; conserve water resources; protect local biodiversity and ecosystem services; promote sustainable and regenerative materials cycles; enhance building quality; enhance resilience to natural, technological, and human-caused hazards; and support the goal of development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

101.2.2 (1.2) This code is intended to provide the technical basis of mandatory building codes and regulations for *high-performance green buildings* that are broadly adoptable by national and local jurisdictions.

101.3 (2.) Scope.

101.3.1 (2.1) This code contains requirements that address *site* sustainability, water use efficiency, energy efficiency, indoor environmental quality (IEQ), materials and resources, and construction and plans for operation. This code applies only to the following *building projects*:

1. New buildings and their systems.
2. New portions of buildings and their systems.
3. New systems and equipment in existing buildings.
4. Relocated existing buildings and temporary structures where specified in this code.

101.3.2 (2.2) The provisions of this code do not apply to the following:

1. Manufactured houses (mobile homes).
2. Manufactured houses (modular).
3. *Building projects* that use none of the following:
    1. Electricity.
    2. Fossil fuels.
    3. Water.

(***Informative note:*** The provisions in Appendix J for resi- dential and multifamily construction apply where adopted by the authority having jurisdiction.)

101.3.3 (2.3) The requirements in this code shall not be used to circumvent any applicable safety, health, or envi- ronmental requirements.

101.4 (4.) Application.

101.4.1(4.1) General. *Building projects* shall comply with one of the following:

1. Achieve Platinum Certification using version 4.1 or later of the US Green Building Council's (USGBC) Leadership in Energy and Environmental (LEED) program. *Residential* and Group-R *buildings* may achieve certification with the LEED for Homes program. All other *building projects* shall achieve certification with the Building Design and Construction (BD +C) program.
2. Achieve Zero Net Energy in accordance with Section 401.5 (4.5) for *residential building projects* or 701.6 (7.6) for all other *building projects*.
3. *Residential building projects shall* comply with Chapters 4 through 6 and 8 through 11. All other *building projects* shall comply with Chapters 5 through 11. Within each of these chapters, *building projects* shall comply with select mandatory provisions (x.3) in accordance with Table 101.4.1 and, where offered, either the:
    - 3.1. Prescriptive Option (x.4) or
    - 3.2. Performance Option (x.5) or
    - 3.3. For Chapters 4 and 7, additional compliance options as defined in those chapters.

Table 101.4.1 Mandatory Requirements

Chapter	Mandatory	Project Electives
Chapter 4	401.3	NA

Chapter 5	**All** of the following sections: 501.3.3.1 501.3.4.6 501.3.5.3 501.3.5.4 501.3.7.2 501.3.7.3	No less than **five** of the following sections: 501.3.2 501.3.4.1 501.3.4.6 501.3.5.1 501.3.5.2 501.3.5.5 501.3.6 501.3.7.1 501.3.8 501.3.9
Chapter 6	**All** of the following sections: 601.3.1.1 601.3.1.2.1 601.3.1.2.2 601.3.2 601.3.3	No less that **one** of the following sections: 601.3.1.2.3 601.3.4 601.3.5 601.3.6 601.3.8
Chapter 7	701.3	NA
Chapter 8	**All** of the following sections: 801.3.1.1 801.3.1.2 801.3.2 801.3.3 801.3.4 801.3.5 801.3.6.3 801.3.9	No less than **five** of the following sections: 801.3.1.3 801.3.1.4 801.3.1.5 801.3.1.6 801.3.1.7 801.3.1.8 801.3.1.9 801.3.1.10 801.3.6.1 801.3.6.2 801.3.7 801.3.8
Chapter 9	**All** of the following sections: 901.3.1.1 901.3.1.3 901.3.3	NA
	901.3.4.5	
Chapter 10	**All** of the following sections: 1001.3.1.1.1 1001.3.1.2 1001.3.1.3 1001.3.1.4 1001.3.2.4	No less than **five** of the following sections: 1001.3.1.1.2 1001.3.1.4 1001.3.1.5 1001.3.1.6 1001.3.1.7 1001.3.1.8 1001.3.1.9 1001.3.1.10 1001.3.2

101.4.2 (4.1.1) Referenced Standards. The standards ref- erenced in this code and listed in Chapter 11 shall be con- sidered to be part of the requirements of this code to the prescribed extent of such reference. All NFPA 70 code references within the Denver Green Code shall refer to the National Electrical Code as adopted by the State of Colorado. Where differences exist between provisions of this code and a referenced standard, the provisions of this code shall apply. Informa- tive references in Informative Appendix G are cited to acknowledge sources and are not part of this code.

101.4.3 (4.1.2) Normative Appendices. The normative appendices to this code are considered to be integral parts of the mandatory requirements of this code, which for rea- sons of convenience are placed apart from all other norma- tive elements.

101.4.4 (4.1.3) Informative Appendices. The informative appendices to this code, and informative notes located within this code, contain additional information and are not mandatory or part of this code.

101.4.5 (4.1.4) Referenced Standard Reproduction Annexes. The referenced standard reproduction annexes contain material that is cited in this code but that is con- tained in another standard. The reference standard repro- duction annexes are not part of this code but are included in its publication to facilitate its use.

SECTION 102
APPLICABILITY

102.1 Code conflicts. Where there is a conflict between a general requirement and a specific requirement of this code, the specific requirement shall be applicable. Where, in any specific case, different sections of the code specify different materials, methods of construction or other requirements, the most practical requirement to meet the intent of the code shall govern.

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

102.3 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.

102.4 Referenced codes and standards. Where adopted by the authority having jurisdiction, the following codes shall be considered to be part of the requirements of this code: *International Building Code*, *International Code Council Performance Code*, *International Energy Conservation Code*, *International Existing Building Code*, *International Fire Code*, *International Fuel Gas Code*, *International Mechanical Code*, *International Plumbing Code*, and *International Residential Code*.

102.4.1 Conflicting provisions. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code or the International Codes as adopted by the authority having jurisdiction listed in Section 102.4, the provisions of this code or the International Codes listed in Section 102.4, as applicable, shall take precedence over the provisions in the referenced code or standard. Where there is a conflict between the provisions of this chapter and the provisions of the *Administration of the 2019 Denver Building Code*, the provisions of the *Administration of the 2019 Denver Building Code* shall govern.

102.4.2 Application of referenced standards. The standards referenced in this code and listed in Chapter 11 shall be considered to be part of the requirements of this code to the prescribed extent of such reference. Where differences exist between the provisions of this code and a referenced standard, the provisions of this code shall apply.

102.5 Partial invalidity. In the event that any part or provision of this code is held to be illegal or void, this shall not have the effect of making void or illegal any of the other parts or provisions.

102.6 Existing structures. The legal occupancy of any structure existing on the date of adoption of this code shall be permitted to continue without change, except as is specifically covered in this code, and where adopted by the authority having jurisdiction, the *International Building Code*, the *International Existing Building Code* or the *International Fire Code*, or as is deemed necessary by the authority having jurisdiction for the general safety and welfare of building occupants and the public.

102.7 Mixed occupancy buildings. In mixed occupancy buildings, each portion of a building shall comply with the specific requirements of this code applicable to each specific occupancy.

PART 2— ADMINISTRATION AND ENFORCEMENT

SECTION 103
RESERVED

SECTION 104
RESERVED

SECTION 105
APPROVAL

105.1 Reserved

105.2 Reserved

105.3 Reserved

105.4 Reserved

105.5 Compliance materials. The authority having jurisdiction shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

105.6 Approved programs. The authority having jurisdiction shall have the authority to deem a national, state or local program as meeting or exceeding this code. Buildings *approved* in writing by such a program shall be considered to be in compliance with this code.

105.6.1 Specific approval. The authority having jurisdic- tion shall have the authority to approve programs or com- pliance tools for a specified application, limited scope or specific locale, including approval that is applicable to a specific section or chapter of this code.

CHAPTER 2

RESERVED

CHAPTER 3
DEFINITIONS, ABBREVIATIONS AND ACRONYMS

301.1 (3.1) General. Certain terms, abbreviations, and acronyms are defined in this chapter for the purposes of this code. These definitions are applicable to all chapters of this code.

Terms that are not defined herein, but that are defined in standards that are referenced herein (***Informative Note:*** e.g., ANSI/ASHRAE/IES Standard 90.1), shall have the meanings as defined in those standards.

Other terms that are not defined shall have their ordinarily accepted meanings within the context in which they are used. Ordinarily accepted meanings shall be based on American standard English language usage, as documented in an unabridged dictionary accepted by the *authority having jurisdiction*.

301.2 (3.2) Definitions.

agricultural land: land that is, or was, within ten years prior to the date of the building permit application for the *building project*, primarily devoted to the commercial production of horticultural, viticultural, floricultural, dairy, apiary, vegetable, or animal products or of berries, grain, hay, straw, turf, seed, finfish in upland hatcheries, or livestock, and that has long-term commercial significance for agricultural production. Land that meets this definition is *agricultural land* regardless of how the land is zoned by the local government with zoning jurisdiction over that land.

air, makeup: see ANSI/ASHRAE Standard 62.1.

air, outdoor: see ANSI/ASHRAE Standard 62.1.

air, transfer: see ANSI/ASHRAE Standard 62.1.

airflow, minimum outdoor: the outdoor airflow provided by a ventilation system to meet requirements for indoor air quality, excluding any additional *outdoor air* intake to reduce or eliminate the need for *mechanical cooling*.

alternative daily cover: cover material, other than earthen material, placed on the surface of the active face of a municipal solid-waste landfill at the end of each operating day to control vectors, fires, odors, blowing litter, and scavenging.

annual sunlight exposure (ASE): the percent of an analysis area that exceeds a specified direct-sunlight illuminance level for more than a specified number of hours per year (Source: IES LM 83). *Annual sunlight exposure* is a metric that quantifies the potential for excessive sunlight in interior work environments.

attic and other roofs: see ANSI/ASHRAE/IES Standard 90.1.

authority having jurisdiction (AHJ): the agency or agent responsible for enforcing this code.

automatic: see ANSI/ASHRAE/IES Standard 90.1.

baseline building design: see ANSI/ASHRAE/IES Standard 90.1.

baseline building performance: see ANSI/ASHRAE/IES Standard 90.1.

Basis of Design (BoD): a document that records the concepts, calculations, decisions, and product selections used to meet the *owner's project requirements* and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process. (See *owner's project requirements*.)

bilevel lighting control: lighting control in a *space* that provides at least one intermediate level of lighting power in addition to fully ON and fully OFF. Continuous dimming systems are covered by this definition.

biobased product: a commercial or industrial product (other than food or feed) that comprises, in whole or in significant part, biological products or renewable agricultural materials (including *plant*, animal, and marine materials) or forestry materials.

biodiverse plantings: nonhomogeneous, multiple-species plantings.

breathing zone: see ANSI/ASHRAE Standard 62.1.

brownfield: a *site* documented as contaminated by means of an ASTM E1903 Phase II Environmental Site Assessment or a *site* classified as a *brownfield* by a local, state, or federal government agency.

building entrance: see ANSI/ASHRAE/IES Standard 90.1.

building envelope: see ANSI/ASHRAE/IES Standard 90.1.

building project: a building, or group of buildings, and *site* that utilize a single submittal for a construction permit or that are within the boundary of contiguous properties under single ownership or effective control. (See *owner*.)

carbon dioxide equivalent (CO_2e): a measure used to compare the impact of various greenhouse gases based on their global warming potential (GWP). CO_2e approximates the time-integrated warming effect of a unit mass of a given greenhouse gas relative to that of carbon dioxide (CO_2). GWP is an index for estimating the relative global warming contribution of atmospheric emissions of 1 kg of a particular greenhouse gas compared to emissions of 1 kg of CO_2. The following GWP values are used based on a 100-year time horizon: 1 for CO_2, 25 for methane (CH_4), and 298 for nitrous oxide (N_2O).

classroom: a *space* primarily used for scheduled instructional activities.

climate zone: see Normative Appendix A.

combined energy efficiency ratio (CEER* [I-P]*) ($CCOP_C$* [SI]*): the combined energy efficiency is a ratio of the total cooling in one year divided by the total energy from active, stand-by, and OFF modes as defined in AHAM Standard RAC-1; Btu/h/W (W/W).

commissioning (Cx) plan: a document that outlines the organization, schedule, allocation of resources, and documentation requirements of the building *commissioning process*. [See *commissioning* (*Cx*) *process*.]

commissioning (Cx) process: a quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the *owner's project requirements*. (See *owner's project requirements*.)

commissioning (Cx) provider: an entity, identified by the *owner* and approved by the *AHJ*, who manages the commissioning team to implement the building *commissioning process*. [See *commissioning* (*Cx*) *process*.]

Informative Note: This entity is sometimes known as a "commissioning authority," "CxA," or "approved agency." [See *commissioning* (*Cx*) *process*.]

conditioned space: see ANSI/ASHRAE/IES Standard 90.1.

construction documents: see ANSI/ASHRAE/IES Standard 90.1.

contaminant: see ANSI/ASHRAE Standard 62.1.

continuous air barrier: see ANSI/ASHRAE/IES Standard 90.1.

cycles of concentration: the ratio of makeup rate to the sum of the blowdown and drift rates.

daylight area: area in an *enclosed space* that is in the *primary sidelighted area*, *daylight area under roof monitors*, or *daylight area under skylights*.

daylight area under roof monitors: see ANSI/ASHRAE/IES Standard 90.1.

daylight area under skylights: see ANSI/ASHRAE/IES Standard 90.1.

daylight hours: the period from 30 minutes after sunrise to 30 minutes before sunset.

demand control ventilation (DCV): see ANSI/ASHRAE/IES Standard 90.1.

densely occupied space: those *spaces* with a design occupant density greater than or equal to 25 people per 1000 ft^2 (100 m^2).

design professional: see ANSI/ASHRAE/IES Standard 90.1.

designated park land: federal-, state-, or local-government-owned land that is formally designated and set aside as park land or a wildlife preserve.

dwelling unit: see ANSI/ASHRAE/IES Standard 90.1.

dynamic glazing: see ANSI/ASHRAE/IES Standard 90.1.

electronics: computers and accessories; monitors; printers; and other equipment, such as scanners, fax machines, electric typewriters, cell phones, telephones, answering machines, shredders, postage machines, televisions, VHS/DVD players, portable cassette/CD players with radio devices, and stereo equipment.

emergency ride home: access to transportation home in the case of a personal emergency or unscheduled overtime for employees who commute via transit, carpool, or vanpool.

enclosed space: see ANSI/ASHRAE/IES Standard 90.1.

evapotranspiration (ET): the sum of evaporation from soil and *plant* surfaces and transpiration of water through leaf stomata.

> ***ET_c:*** *evapotranspiration* of the *plant* material derived by multiplying ET_o by the appropriate *plant* factor or coefficient.
>
> ***ET_o:*** reference *evapotranspiration* for a cool-season grass as calculated by the standardized Penman-Monteith equation based on weather-station data.

fenestration: see ANSI/ASHRAE/IES Standard 90.1.

fenestration area: see ANSI/ASHRAE/IES Standard 90.1.

fish and wildlife habitat conservation area: areas with which state or federally designated endangered, threatened, or sensitive species have a primary association.

forest land: all designated state forests, national forests, and all land that is, or was, within ten years prior to the date of the building permit for the *building project*, primarily devoted to growing trees for long-term commercial timber production.

functional and performance testing (FPT): testing performed to ensure that designated systems of the project meet the intended design performance requirements.

functional and performance testing provider (FPT provider): an entity identified by the *owner* who manages the activities needed to implement the building *functional and performance testing (FPT)* activities.

generally accepted engineering standard: see ANSI/ASHRAE/IES Standard 90.1.

geothermal energy: heat extracted from the Earth's interior that is used to produce electricity or mechanical power or to provide thermal energy for heating buildings or processes. *Geothermal energy* does not include systems such as heat pumps that use energy independent of the geothermal source to raise the temperature of the extracted heat.

greenfield: a *site* of which 20% or less has been previously developed with impervious surfaces.

greyfield: a *site* of which more than 20% is currently or has been previously developed with impervious surfaces.

gross roof area: see ANSI/ASHRAE/IES Standard 90.1.

gross wall area: see ANSI/ASHRAE/IES Standard 90.1.

ground cover: plantings other than *turfgrass* that are low-growing and form dense vegetation over the soil area.

hardscape: *site* paved areas, including roads, driveways, parking lots, walkways, courtyards, and plazas.

heat island effect: the tendency of urban areas to be at a warmer temperature than surrounding rural areas.

high-performance green building: a building designed, constructed, and capable of being operated in a manner that increases environmental performance and economic value over time, seeks to establish an indoor environment that sup-

ports the health of occupants, and enhances satisfaction and productivity of occupants through integration of environmentally preferable building materials and water-efficient and energy-efficient systems.

high-speed door: a nonswinging door used primarily to facilitate vehicular access or material transportation, and having an *automatic* closing device with an opening rate of not less than 32 in./s (810 mm/s) and a closing rate of not less than 24 in./s (610 mm/s).

hourly average sound pressure level (L_{eq}): time-mean-square frequency-weighted sound pressure level for one hour

hydrozone: an irrigated area of landscape in which the *plants* have similar water needs and are irrigated by the same type of emission devices.

improved landscape: any disturbed area of the *site* where new *plant* and/or grass materials are to be used, including green *roofs*, plantings for stormwater controls, planting boxes, and similar vegetative use. *Improved landscape* shall not include *hardscape* areas such as sidewalks, driveways, other paved areas, and swimming pools or decking.

institutional tuning: the process, by authorized personnel, of adjusting the maximum light output of individual luminaires, groups of luminaires, or entire lighting systems to support visual needs or to save energy. *Institutional tuning* is also known as "high-end trim control."

integrated design process: a design process using early collaboration among representatives of each stakeholder and participating consultant on the project. Unlike the conventional, or linear, design process, integrated design requires broad stakeholder/consultant participation.

***integrated project delivery*:** see *integrated design process*.

interior projection factor (PF): see *projection factor, interior*.

irrigation adequacy: a representation of how well irrigation meets the needs of the *plant* material. This reflects the percentage of required water for turf or *plant* material supplied by rainfall and controller-scheduled irrigations.

irrigation excess: a representation of the amount of irrigation water applied beyond the needs of the *plant* material. This reflects the percentage of water applied in excess of 100% of required water.

irrigation station: a set of irrigation emission devices supplied water by a single control valve. Also referred to as an "irrigation zone."

isolation devices: see ANSI/ASHRAE/IES Standard 90.1.

landscape establishment period: a time period, beginning on the date of completion of permanent plantings and not exceeding 18 months, intended to allow the permanent landscape to become sufficiently established to remain viable.

life-cycle assessment (LCA): a compilation and evaluation of the inputs, outputs, and potential environmental impacts of a building system throughout its life cycle. *LCA* addresses the environmental aspects and potential environmental impacts, (e.g., use of resources and environmental consequences of releases) throughout a building's life cycle, from raw material acquisition through manufacturing, construction, use, operation, end-of-life treatment, recycling, and final disposal (end of life). The purpose is to identify opportunities to improve the environmental performance of buildings throughout their life cycles.

lighting power allowance: see ANSI/ASHRAE/IES Standard 90.1.

lighting quality: the degree to which the luminous environment in a *space* supports the requirements of the occupants.

lighting zone (LZ): an area defining limitations for outdoor lighting.

> ***LZ0:*** undeveloped areas within national parks, state parks, *forest land*, rural areas, and other undeveloped areas as defined by the *AHJ*.
>
> ***LZ1:*** developed areas of national parks, state parks, *forest land*, and rural areas.
>
> ***LZ2:*** areas predominantly consisting of *residential* zoning, neighborhood business districts, light industrial with limited night time use, and *residential* mixed-use.
>
> ***LZ3:*** all areas not included in *LZ0*, *LZ1*, *LZ2*, or *LZ4*.
>
> ***LZ4:*** high-activity commercial districts in major metropolitan areas as designated by the local jurisdiction.

liner system (Ls): an insulation system for a metal building *roof* that includes the following components. A continuous membrane is installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins. For multilayer installations, the last rated R-value of insulation is for unfaced insulation draped over purlins and then compressed when the metal *roof* panels are attached. A minimum R-3 (R-0.5) thermal spacer block between the purlins and the metal *roof* panels is required unless compliance is shown by the overall assembly U-factor or otherwise noted.

low-impact trail: erosion-stabilized pathway or track that uses natural groundcover or installed system greater than 50% pervious. The pathway or track is designed and used only for pedestrian and nonmotorized vehicles (excluding power-assisted conveyances for individuals with disabilities).

maintenance plan: see *maintenance program* in ANSI/ASHRAE/ACCA Standard 180.

maximum sound pressure level (L_{max}): greatest frequency-weighted and exponential-time-weighted sound level within a stated time interval.

mechanical cooling: see ANSI/ASHRAE/IES Standard 90.1.

multilevel lighting control: lighting control in a *space* that provides at least two intermediate levels of lighting power in addition to fully ON and fully OFF. Continuous dimming systems are covered by this definition.

networked guest-room control system: an energy management control system, accessible from the hotel/motel front desk or other central location, that is capable of identifying reserved rooms according to a timed schedule and is capable of controlling each hotel/motel guest room separately.

nonresidential: see ANSI/ASHRAE/IES Standard 90.1.

nonstandard part-load value (NPLV): see ANSI/ASHRAE/IES Standard 90.1.

north-oriented: facing within 45 degrees of true north within the northern hemisphere (however, facing within 45 degrees of true south in the southern hemisphere).

occupant load: the number of persons for which the means of egress of a building or portion thereof is designed.

occupiable space: see ANSI/ASHRAE Standard 62.1.

office furniture system: either a panel-based workstation comprising modular interconnecting panels, hang-on components, and drawer/filing components, or a freestanding grouping of furniture items and their components that have been designed to work in concert.

once-through cooling: the use of water as a cooling medium, where the water is passed through a heat exchanger one time and is then discharged to the drainage system. This also includes the use of water to reduce the temperature of condensate or process water before discharging it to the drainage system.

on-site renewable energy system: photovoltaic, solar thermal, *geothermal energy*, and wind systems used to generate energy and located on the *building project*.

open-graded (uniform-sized) aggregate: materials such as crushed stone or decomposed granite that provide 30% to 40% void *spaces*.

outdoor air fault condition: a situation in which the measured *minimum outdoor airflow* of a ventilation system is 10% or more below the set-point value that corresponds to the occupancy and operation conditions at the time of the measurement.

owner: the party in responsible control of development, construction, or operation of a project at any given time.

owner's project requirements (OPR): a document that specifies the functional requirements of a project and the expectations of how it will be used and operated, including project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, training requirements, documentation requirements, and supporting information.

permanently installed: see ANSI/ASHRAE/IES Standard 90.1.

permeable pavement: pervious concrete or porous asphalt that allows the movement of water and air through the paving material and which is primarily used as paving for roads, parking lots, and walkways. Permeable paving materials have an open-graded coarse aggregate with interconnected voids.

permeable pavers: units that present a solid surface but allow natural drainage and migration of water into the base below by permitting water to drain through the *spaces* between the pavers.

plants:

a. ***adapted plants:*** *plants* that reliably grow well in a given habitat with minimal attention from humans in the form of winter protection, pest protection, water irrigation, or fertilization once root systems are established in the soil. *Adapted plants* are considered to be low maintenance but not invasive.

b. ***invasive plants:*** species of *plants* that are not native to the *building project site* and that cause or are likely to cause environmental harm. At a minimum, the list of invasive species for a *building project site* includes *plants* included in city, county, and regional lists and state and federal noxious weeds laws.

c. ***native plants:*** *plants* that adapted to a given area during a defined time period and are not invasive. In America, the term often refers to *plants* growing in a region prior to the time of settlement by people of European descent.

d. ***rainfall-ET_c compatible plants:*** *plants* with documented ET_c rates and having all of the following characteristics: (1) not native or invasive to the local geographic area of the *site*; (2) after the *landscape establishment period*, do not require supplemental annual irrigation, based on the ten-year average annual rainfall of the local climate and based on 80% of the *plant*'s ET_c.

porous pavers (open-grid pavers): units where at least 40% of the surface area consists of holes or openings that are filled with sand, gravel, other porous material, or vegetation.

postconsumer recycled content: proportion of *recycled material* in a product generated by households or by commercial, industrial, and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. This includes returns of material from the distribution chain. (See *recycled material*.)

preconsumer recycled content: proportion of *recycled material* in a product diverted from the waste stream during the manufacturing process. Content that shall not be considered preconsumer recycled includes the reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it. (See *recycled material*.)

primary sidelighted area: see ANSI/ASHRAE/IES Standard 90.1.

projection factor (PF): see ANSI/ASHRAE/IES Standard 90.1.

projection factor (PF), interior: the ratio of the horizontal depth of the interior shading projection divided by the sum of the height of the *fenestration* above the interior shading projection and, if the interior projection is below the bottom of the *fenestration*, the vertical distance from the bottom of the *fenestration* to the top of the farthest point of the interior shading projection, in consistent units.

proposed building performance: see ANSI/ASHRAE/IES Standard 90.1.

proposed design: see ANSI/ASHRAE/IES Standard 90.1.

public way: a street, alley, transit right of way, or other parcel of land open to the outdoors and leading to a street or transit right of way that has been deeded, dedicated, or otherwise permanently appropriated for public use and that has a clear width and height of not less than 10 ft (3 m).

REC: see *renewable energy certificate (REC)*.

recovered material: material that would have otherwise been disposed of as waste or used for energy recovery (***Informative Note:*** e.g., incinerated for power generation) but has instead been collected and recovered as a material input, in lieu of new primary material, for a recycling or a manufacturing process.

recycled content: proportion by mass of *recycled material* in a product or packaging. Only preconsumer and postconsumer materials shall be considered as *recycled content*. (See *recycled material*.)

recycled material: material that has been reprocessed from *recovered* (reclaimed) *material* by means of a manufacturing process and made into a final product or into a component for incorporation into a product. (See *recovered material*.)

regulated energy use: see ANSI/ASHRAE/IES Standard 90.1.

renewable energy certificate (REC): a tradable instrument that represents the environmental attributes of one megawatt-hour of renewable electricity generation and is transacted separately from the electricity generated by the renewable energy source.

residential: see ANSI/ASHRAE/IES Standard 90.1.

roof: see ANSI/ASHRAE/IES Standard 90.1.

roof area, gross: see ANSI/ASHRAE/IES Standard 90.1.

roof monitor: see ANSI/ASHRAE/IES Standard 90.1.

salvaged material: material, component, or assembly removed in a whole form from a structure or *site* in which it was *permanently installed* and subsequently reused in the *building project*.

seating: task and guest chairs used with *office furniture systems*.

secondary sidelighted area: see ANSI/ASHRAE/IES Standard 90.1.

semiheated space: see ANSI/ASHRAE/IES Standard 90.1.

service water heating: see ANSI/ASHRAE/IES Standard 90.1.

sidelighting: daylighting provided by *vertical fenestration* mounted below the ceiling plane.

sidelighting effective aperture: the relationship of daylight transmitted through *vertical fenestration* to the *primary sidelighted areas*. The *sidelighting effective aperture* is calculated according to the following formula:

$$\text{Sidelighting effective aperture} = \frac{\sum \text{Vertical fenestration area} \times \text{Vertical fenestration VT}}{\text{Area of primary sidelighted area}}$$

where *Vertical fenestration* VT is the visible transmittance of vertical fenestration as determined in accordance with NFRC 200. For products outside the scope of NFRC 200, VT is the solar photometric transmittance of the glazing materials as determined in accordance with ASTM E972.

single-rafter roof: see ANSI/ASHRAE/IES Standard 90.1.

site: a contiguous area of land that is under the ownership or control of one entity.

skylight: see ANSI/ASHRAE/IES Standard 90.1.

skylight effective aperture: see ANSI/ASHRAE/IES Standard 90.1.

smart controller (weather-based irrigation controller): a device that estimates or measures depletion of water from the soil moisture reservoir and operates an irrigation system to replenish water as needed while minimizing excess.

soil-gas retarder system: a combination of measures that retard vapors in the soil from entering the occupied *space*.

solar energy system: any device or combination of devices or elements that rely on direct sunlight as an energy source, including, but not limited to, any substance or device that collects sunlight for use in

a. heating or cooling of a structure or building;
b. heating or pumping of water;
c. industrial, commercial, or agricultural processes; and
d. generation of electricity.

solar heat gain coefficient (SHGC): see ANSI/ASHRAE/IES Standard 90.1.

solar reflectance index (SRI): a measure of a constructed surface's ability to reflect solar heat, as shown by a small temperature rise. A standard black surface (reflectance 0.05, emittance 0.90) is 0, and a standard white surface (reflectance 0.80, emittance 0.90) is 100.

space: see ANSI/ASHRAE/IES Standard 90.1.

spatial daylight autonomy (sDA): the percent of an analysis area that meets a minimum daylight illuminance level for a specified fraction of the hours per year (Source: IES LM 83). *Spatial daylight autonomy* is a metric quantifying annual sufficiency of ambient daylight levels in interior *spaces*.

specular visible transmittance: the fraction of incident flux (lumens) that passes directly through a surface or medium without scattering.

***SWAT*:** smart water application technology as defined by the Irrigation Association.

task lighting: see ANSI/ASHRAE/IES Standard 90.1.

tubular daylighting device: a means to capture sunlight from a rooftop. Sunlight is then redirected down from a highly reflective shaft and diffused throughout interior *space*.

turfgrass: grasses that are regularly mowed and, as a consequence, form a dense growth of leaf blades, shoots, and roots.

unregulated energy use: see ANSI/ASHRAE/IES Standard 90.1.

variable-air-volume (VAV) system: see ANSI/ASHRAE/IES Standard 90.1.

vendor: a company that furnishes products to project contractors and/or subcontractors for on-site installation.

verification: the process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the *owner's project requirements*. (See *owner's project requirements*.)

vertical fenestration: see ANSI/ASHRAE/IES Standard 90.1.

view fenestration: *fenestration* that complies with all of the following:

a. It provides building occupants with a view to the outdoors or to an interior daylit atrium.

b. It has undiffused glazing with a haze value less than 3%, as determined in accordance with ASTM D1003.

c. It has a center-of-glass visible transmittance (VT) of not less than 20%.

d. The product of the center-of-glass VT and the openness factor of screens, patterned films, and ceramic frits is not less than 20%.

e. Where *dynamic glazing* is provided, such glazing has a center-of-glass VT of not less than 20% at the highest end of its range.

f. Where nonoperable opaque window treatments are provided, such as blinds, shades, and louvers, such treatments do not obstruct more than 40% of the *fenestration* glazing area.

wall: see ANSI/ASHRAE/IES Standard 90.1.

wall area, gross: see ANSI/ASHRAE/IES Standard 90.1.

water, alternate on-site sources of: *alternate on-site sources of water* include, but are not limited to:

a. rainwater or stormwater harvesting,

b. air conditioner condensate,

c. grey water from interior applications and treated as required,

d. swimming-pool filter backwash water,

e. cooling-tower blowdown water,

f. foundation drain water,

g. industrial process water, and

h. on-site wastewater treatment *plant* effluent.

water, nonpotable: water that is not *potable water*. (See *water, potable*.)

water, potable: water from public drinking water systems or from natural freshwater sources, such as lakes, streams, and aquifers, where water from such natural sources would or could meet drinking water standards.

water, reclaimed: *nonpotable water* derived from the treatment of waste water by a facility or system licensed or permitted to produce water meeting the jurisdiction's water requirements for its intended uses, including, but not limited to, above-surface landscape irrigation.

water-bottle filling station: a plumbing fixture or fixture fitting that is controlled by the user for the sole intended purpose of dispensing *potable water* into a personal drinking water bottle. Such fixtures and fittings are connected to the *potable water* distribution system of the premises and can be stand-alone fixtures or integrated with another fixture.

water factor (WF):

a. ***clothes washer (residential* and *commercial):*** the quantity of water in gallons (litres) used to wash each cubic foot (cubic metre) of machine capacity.

b. ***residential dishwasher:*** the quantity of water use in gallons (litres) per full machine wash and rinse cycle.

weatherproofing system: a group of components, including associated adhesives and primers, that when installed create a protective envelope against water and wind.

wetlands: those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions. This definition incorporates all areas that would meet the definition of "wetlands" under applicable federal or state guidance—regardless of whether they are officially designated, delineated, or mapped—including man-made areas that are designed, constructed, or restored to include the ecological functions of natural *wetlands*.

301.3 (3.3) Abbreviations and Acronyms

µg	microgram
AC	alternating current
AHJ	*authority having jurisdiction*
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
ANSI	American National Standards Institute
ASE	*annual sunlight exposure*
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials International
BIFMA	The Business and Institutional Furniture Manufacturer's Association
BMS	building management system
BoD	*Basis of Design*
BPF	building performance factor
Btu	British thermal unit
Btu/h	British thermal unit per hour
BUG	backlight, uplight, and glare
CAC	ceiling attenuation class
CCOP	*combined coefficient of performance*
CDPH	California Department of Public Health
CEER	*combined energy efficiency ratio*
CFC	Chlorofluorocarbon
cfm	cubic feet per minute (ft^3/min)
CH_4	methane
c.i.	continuous insulation

CIE	Commission Internationale de L'Eclairage (International Commission on Illumination)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO_2	carbon dioxide
CO_2e	*carbon dioxide equivalent*
CSA	Canadian Standards Association
cSTC	composite sound transmission class
Cx	commissioning
dB	decibel
db	dry bulb
dBA	decibel, A-weighting
dBC	decibel, C-weighting
DC	direct current
DCV	*demand control ventilation*
DR	demand response
EISA	Energy Independence and Security Act
EMS	Energy Management System
EPAct	U.S. Energy Policy Act
EPD	environmental product declaration
ESC	erosion and sedimentation control
ET_c	*evapotranspiration*
ET_o	*maximum evapotranspiration*
ETS	environmental tobacco smoke
fc	footcandle
FF&E	furniture, fixtures, and equipment
FPT	*functional and performance testing*
ft	foot
gal	gallon
gpm	gallons per minute
GWP	global warming potential
h	hour
ha	hectare
HCFC	hydrochlorofluorocarbon
HID	high-intensity discharge
HVAC	heating, ventilation, and air conditioning
HVAC&R	heating, ventilation, air conditioning, and refrigeration
Hz	hertz
IA	Irrigation Association
IAPMO	International Association of Plumbing and Mechanical Officials
IAQ	indoor air quality
IECC	International Energy Conservation Code
IEQ	indoor environmental quality
IES	Illuminating Engineering Society
IIC	impact insulation class
in.	inch
I-P	inch-pound
ISR	impact sound rating
kg	kilogram
km	kilometre
kVA	kilovolt-ampere
kW	kilowatt
kWh	kilowatt-hour
L	litre
lb	pound
LCA	*life-cycle assessment*
LCI	life-cycle inventory
L_{eq}	hourly average sound pressure level
L_{max}	*maximum sound pressure level*
LPD	lighting power density
Ls	*liner system*
LZ	*lighting zone*
m	metre
MDF	medium density fiberboard
MERV	minimum efficiency reporting value
mg	milligram
mi	mile
min	minute
mm	millimetre
mph	miles per hour
M&V	measurement and *verification*
N_2O	nitrous oxide
NA	not applicable
NAECA	National Appliance Energy Conservation Act
NIC	noise isolation class
NISR	normalized impact sound rating
NNIC	normalized noise isolation class
NPLV	nonstandard part-load value
NR	not required
OITC	outdoor-indoor transmission class
O&M	operations and maintenance
OPR	*owner's project requirements*
Pa	Pascal
PCI	Performance Cost Index
PF	*projection factor*
ppm	parts per million
RCR	room cavity ratio

REC	*renewable energy certificate*
s	second
SCAQMD	South Coast Air Quality Management District
sDA	*spatial daylight autonomy*
SHGC	*solar heat gain coefficient*
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SRI	*solar reflectance index*
STC	sound transmission class
SWAT	smart water application technology
T_{60}	reverberation time in seconds
UL	Underwriters Laboratory
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFEMA	United States Federal Emergency Management Agency
USGBC	United States Green Building Council
VAV	*variable air volume*
VOC	volatile organic compound
VRF	variable refrigerant flow system
VT	visible transmittance
wb	wet bulb
WF	*water factor*
yr	year

CHAPTER 4

RESIDENTIAL ENERGY EFFICIENCY

401.1 (4.1) Scope. This section specifies requirements for energy efficiency for *residential* buildings and appliances, and for *on-site renewable energy systems*.

401.2 (4.2) Compliance. The energy systems shall comply with Section 401.3, "Mandatory Provisions," and one of the following:

1. Section 401.4, "Passive House Approach"
2. Section 401.5, "Net Zero Approach," or
3. Section 401.6, "Energy Rating Approach."

401.3 (4.3) Mandatory Provisions.

401.3.1. (4.3.1) Provisions for electric-vehicle charging. The building shall be provided with electric charging in accordance with this section and the *National Electrical Code* (NFPA 70) and this section. New one- and two-family dwellings and townhouses with attached and detached private garages shall be provided with one *EV Ready Space*. When parking spaces are added or modified without an increase in building size, only the new parking spaces are subject to this requirement.

EXCEPTION: Detached private garages without electrical service.

401.4 (4.4) Energy Rating Approach. Compliance with this section requires that the *rated design* be shown to have an Energy Rating Index score of less than or equal to 50 when compared to the *ERI reference design* determined in accordance with RESNET/ICC 301. The ERI value shall include onsite power production calculated in accordance with RESNET/ICC 301. All space heating and cooling systems, water heating, cooking and clothes dryers shall be electric.

401.4.1 (4.4.1) Verification by approved agency. Verification of compliance with this section shall be completed by an *approved* third party.

401.4.2 (4.4.2) Documentation. Documentation of the software used to determine the ERI and the parameters for the *residential building* shall be in accordance with Sections 401.4.1 through 401.4.3.

401.4.2.1 (4.4.2.1) Compliance software tools. Software tools used for determining ERI shall be Approved Software Rating Tools in accordance with RESNET/ICC 301.

401.4.2.2 (4.4.2.2 Compliance report. Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Section R401.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.

401.4.2.3 (4.4.2.3) 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*.
4. Within 24 months of occupancy, documentation that on an annual basis, the energy consumed on site by the *building project* is less than the energy produced by an *on-site renewable energy system.*

401.5 (4.5) Net Zero Approach. Compliance with this section requires that the *rated design* be shown to have an Energy Rating Index score of less than or equal to 0 when compared to the *ERI reference design* determined in accordance with RESNET/ICC 301. The ERI value shall include onsite power production calculated in accordance with RESNET/ICC 301. The following shall also be complied with:

a. All space heating and cooling systems, water heating, cooking and clothes dryers shall be electric.
b. The *building* or dwelling unit shall be tested and verified as having an air leakage rate not exceeding two air changes per hour. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals).
c. The building shall be provided with a heat recovery or energy recovery ventilation system. The system shall be balanced with a minimum sensible heat recovery efficiency of 65% at 32°F (0°C) and at rated airflow.

401.5.1 (4.5.1) Documentation and verification. Buildings shall also comply with 401.4.1 through 401.4.3.

401.6 (4.6.) Passive House Approach. New residential buildings shall comply with 401.6.1 of 401.6.2.

401.6.1. (4.6.1) Passive House Institute US (PHIUS) Certification. Achieve certification with the PHIUS+ 2018 Passive Building Standard and provide documentation in accordance with 401.6.1.1.

401.6.1.1 (4.6.1.1) Documentation. Provide documentation to the code official demonstrating the following.

1. Prior to the issuance of a building permit, documentation of a PHIUS+ 2018 Certification Contract from PHIUS and a list of compliance features.
2. Prior to the issuance of a certificate of occupancy, copy of the final report submitted on a form that is approved by PHIUS to document compliance with the PHIUS+ 2018 Standard

401.6.2 (4.6.2) Passive House Institute (PHI) Certification. Achieve certification with the PHI Passive House Standard provide documentation in accordance with 401.6.2.1.

401.6.2.1 (4.6.2.1) Documentation. Provide documentation to the code official demonstrating the following.

1. Prior to the issuance of a building permit, signed documentation from a PHI accredited Passive House Certifier of intent to certify building and a list of compliance features.
2. Prior to the issuance of a certificate of occupancy, a copy of the final report submitted on a form that is approved by PHI to document compliance with the Passive House Standard

CHAPTER 5

SITE SUSTAINABILITY

501.1 (5.1) Scope. This section addresses requirements for *building projects* that pertain to *site* selection, *site* development, mitigation of *heat island effect*, light pollution reduction, and mitigation of transportation impacts.

501.2 (5.2) Compliance. *Building projects* shall comply with Section 501.3 in accordance with Section 101.4.1.

501.3 (5.3) Mandatory Provisions.

501.3.1 (5.3.1) Reserved

(5.3.2) Predesign Site Inventory and Assessment. A predesign inventory and assessment of the natural resources of the *building project site* shall be submitted with the *site* design and *construction documents*. The inventory and assessment shall include all of the follow- ing:

a. Location of land having an elevation lower than 2 ft above the elevation of the 100 year flood, as defined by U.S. FEMA that is located on or adjacent to the *building project site*.

b. Identification of *invasive plant* species on the *site*.

c. Identification of *native plant* species on the *site*.

d. Identification of *site* features designated for preser- vation.

501.3.3 (5.3.3) Plants.

501.3.3.1 (5.3.3.1) Invasive Plants. *Invasive plants* and noxious weed species that appear on the Colorado Department of Agriculture's Noxious Weed List shall be removed from the *building project site* and destroyed or disposed of in a land fill. *Invasive plants* shall not be planted on the *building project site*.

501.3.3.2 (5.3.3.2) Existing Native or Adapted Plants.

a. **More than 20% existing native or adapted plants:** Where more than 20% of the area of the predevelopment *site* has existing *native plants* or *adapted plants*, a minimum area of 10% the building or addition's gross floor area, or 20% of the area of *native plants* or *adapted plants* shall be retained.

b. Less than 20% existing native or adapted plants:

1. Where 20% or less of the area of the predevelopment *site* has existing *native plants* or *adapted plants*, a minimum area of 10% of the building or addition's gross floor area shall be developed or retained as at-grade green space as defined by Denver's Green Building Ordinance.

501.3.3.3 A minimum of 20% of the *site* shall be developed or retained as vegetated area.Such vegetated areas include bioretention facilities, rain gardens, filter strips, grass swales, vegetated level spread- ers, constructed *wetlands*, planters, and open *space* with plantings(5.3.3.2) Mulching of Shrub Bed/Planting Areas. Shrub bed/planting areas shall be mulched to a depth of 2-4in. Perennials and groundcover areas shall be mulched with a 3 in layer. No weed barrier shall be installed over top of tree root balls or in planting beds. The mulch shall meet the following requirements:

1. Be an organic shredded wood mulch that is certified pathogen-free and chemical-free.

2. Surface coverage shall be a minimum 3 foot radius from the trunk where there are no obstructions.

3. Mulch shall be kept a minimum of 4-6 inches away from tree trunks and shall not be in contact with the base of other woody landscape plants.

501.3.4 (5.3.4) Stormwater Management. Stormwater management systems shall be provided on the building *site*.

501.3.5.1 (5.3.4.1) Projects on Greenfields. Projects on *greenfields* shall comply with at least one of the following:

a. Stormwater management systems shall retain on *site* no less than the volume of precipitation during a single 24 h period equal to the 95th percentile precipitation event. *Building projects* with stormwater management systems that are designed to retain volumes greater than that of the 98th percentile precipitation event shall conduct a hydrologic analysis of the building *site* to determine the water balance of the *site* prior to its development, clearing, and filling and to demonstrate that the stormwater management system will not cause ecological impairment by starving receiving waters downstream of the *site*.

b. The stormwater management system design shall maintain *site* water balance (the combined runoff,

infiltration, and *evapotranspiration*) based on a hydrologic analysis of the *site*'s conditions prior to development, clearing, and filling. Postconstruction runoff rate, volume, and duration shall not exceed rates preceding development, clear- ing, or filling of the *site*.

(5.3.4.2)Reserved(5.3.4.3) Reserved(5.3.4.4) Reserved(5.3.4.5) Reserved501.3.4.6 (5.3.4.6) Coal Tar Sealants. The use of tar sealants shall be prohibited in any application exposed to stormwater, wash waters, condensates, irrigation water, snowmelt, or icemelt.

501.3.5 (5.3.5) Mitigation of Heat Island Effect.

501.3.5.1 (5.3.5.1) Site Hardscape. At least 50% of the *site hardscape* that is not covered by *solar energy sys- tems* shall be provided with one or any combination of the following:

a. Existing trees and vegetation or new *biodiverse plantings* of *native plants* and *adapted plants*, which shall be planted either prior to the final approval by the *AHJ* or in accordance with a con- tract established to require planting no later than 12 months after the final approval by the *AHJ* so as to provide the required shade no later than ten years after the final approval. The effective shade coverage on the *hardscape* shall be the arithmetic mean of the shade coverage calculated at 10 a.m., noon, and 3 p.m. on the summer solstice.

b. Paving materials with a minimum initial *solar reflectance index* (*SRI*) of 29. A default *SRI* value of 35 for new concrete without added color pigment is allowed to be used instead of measurements.

c. *Open-graded (uniform-sized) aggregate*, *permeable pavement*, *permeable pavers*, and *porous pavers (open-grid pavers)*. *Permeable pavement* and *permeable pavers* shall have a percolation rate of not less than 2 gal/min·ft^2 (100 L/min·m^2).

d. Shading through the use of structures, provided that the top surface of the shading structure complies with the provisions of Section 501.3.5.3 (5.3.5.3).

e. Parking under a building, provided that the *roof* of the building complies with the provisions of Section 501.3.5.3 (5.3.5.3).

f, Buildings or structures that provide shade to the *site hardscape*. The effective shade coverage on the *hardscape* shall be the arithmetic mean of the shade coverage calculated at 10 a.m., noon, and 3 p.m. on the summer solstice.

501.3.5.2 (5.3.5.2) Reserved

(5.3.5.3) Roofs. This section applies to the building and covered parking *roof* surfaces A minimum of 75% of the *roof* surface shall be covered with products that:

a. have a minimum three-year-aged *SRI* of 64 in accordance with Section 501.3.5.4 (5.3.5.4) for *roofs* with a slope of less than or equal to 2:12.

b. have a minimum three-year-aged *SRI* of 25 in accordance with Section 501.3.5.4 (5.3.5.4) for *roofs* with a slope of more than 2:12.

The area occupied by one or more of the following shall be excluded from the calculation to determine the *roof* surface area required to comply with this section:

a. *Roof* penetrations and associated equipment.

b. *On-site renewable energy systems*, including photovoltaics, solar thermal energy collectors, and required access around the panels or collec- tors.

c. Portions of the *roof* used to capture heat for building energy technologies.

d. *Roof* decks and rooftop walkways.

e. Vegetated terrace and roofing systems complying with Section 501.3.5.5 (5.3.5.5).

Exceptions:

1. *Building projects* where an annual energy analysis simulation demonstrates that the total annual building energy cost and total annual CO_2e, as calculated in accordance with Sec- tion 701.5.2 (7.5.2), are both a minimum of 2% less for the proposed *roof* than for a *roof* material complying with the *SRI* requirements of Section 501.3.5.3 (5.3.5.3).

2. *Roofs* used to shade or cover parking and *roofs* over *semiheated spaces*, provided that they have a minimum initial *SRI* of 29. A default *SRI* value of 35 for new concrete without added color pigment is allowed to be used instead of measurements.

501.3.5.3 (5.3.5.4) Solar Reflectance Index (SRI). The *SRI* shall be calculated in accordance with ASTM E1980 for medium-speed wind conditions using a convection coefficient of 2.1 Btu/h·ft^{2}·°F (11.9 W/m^{2}·°C) for the following conditions:

a. For materials other than *roofs*, the *SRI* shall be based on solar reflectance, as measured in accordance with ASTM E1918 or ASTM C1549, and the thermal emittance, as measured in accordance with ASTM E408 or ASTM C1371. The values for solar reflectance and thermal emittance shall be determined and certified by an independent third party.

b. For roofing products, the *SRI* values shall be based on a minimum three-year-aged solar reflectance and thermal emittance, as measured in accordance with CRRC S100, and shall be certified by the manufacturer.

501.3.5.4

501.3.6 (5.3.6) Reduction of Light Pollution.

501.3.6.1 (5.3.6.1) General. Exterior lighting systems shall comply with ANSI/ASHRAE/IES Standard 90.1, Sections 9.1, 9.4.1.4, 9.4.2, 9.4.3, and 9.7, and with Sections 501.3.6.2 (5.3.6.2) and 501.3.6.3 (5.3.6.3) of this code.

501.3.6.2 (5.3.6.2) Backlight and Glare.

a. All building-mounted luminaires located less than two mounting heights from any property line shall meet the maximum allowable glare ratings in Table 501.3.6.2A (5.3.6.2A).

b. All other luminaires shall meet the maximum allowable backlight and glare ratings in Table 501.3.6.2B (5.3.6.2B).

Exceptions:

1. Specialized signal, directional, and marker lighting associated with transportation.
2. Advertising signage or directional signage.
3. Lighting integral to equipment or instrumen- tation and installed by its manufacturer.
4. Lighting for theatrical purposes, including performance, stage, film production, and video production.
5. Lighting for athletic playing areas.
6. Lighting that is in use for no more than 60 continuous days and is not reinstalled any sooner than 60 days after being uninstalled.
7. Lighting for industrial production, material handling, transportation *sites*, and associated storage areas.
8. Theme elements in theme/amusement parks.
9. Roadway lighting required by governmental authorities.
10. Lighting classified for and used in hazardous locations as specified in NFPA 70.
11. Lighting for swimming pools and water fea- tures.

501.3.6.3 (5.3.6.3) Uplight. All exterior lighting shall meet one of the following uplight requirements:

a. Exterior luminaires shall meet the maximum allowable Uplight Ratings of Table 501.3.6.2B (5.3.6.2B).

b. Exterior lighting shall meet the uplight require- ments of Table 501.3.6.3 (5.3.6.3).

Exceptions:

1. Specialized signal, directional, and marker lighting associated with transportation.
2. Advertising signage or directional signage.
3. Lighting integral to equipment or instrumen- tation and installed by its manufacturer.

4. Lighting for theatrical purposes, including performance, stage, film production, and video production.
5. Lighting for athletic playing areas.
6. Lighting that is in use for no more than 60 continuous days and is not reinstalled any sooner than 60 days after being uninstalled.
7. Lighting for industrial production, material handling, transportation *sites*, and associated storage areas.
8. Theme elements in theme/amusement parks.
9. Roadway lighting required by governmental authorities.
10. Lighting classified for and used in hazardous locations as specified in NFPA 70.
11. Lighting for swimming pools and water fea- tures.

TABLE 501.3.6.2A (TABLE 5.3.6.2A)
MAXIMUM ALLOWABLE GLARE RATINGS FOR BUILDING-MOUNTED LUMINAIRES WITHIN TWO MOUNTING HEIGHTS OF ANY PROPERTY LINE[a,b]

DISTANCE IN MOUNTING HEIGHTS TO NEAREST PROPERTY LINE	LZ0	LZ1	LZ2	LZ3	
≥ 1 and < 2	G0	G0	G1	G1	
≥ 0.5 and < 1	G0	G0	G0	G1	
< 0.5	G0	G0	G0	G0	

a. For property lines that abut public walkways, bikeways, plazas, and parking lots, the property line may be considered to be 5 ft (1.5 m) beyond the actual property line for the purpose of determining compliance with this section. For property lines that abut public roadways and public transit corridors, the property line may be considered to be the centerline of the public roadway or public transit corridor for the purpose of determining compliance with this section.
b. Backlight, uplight, and glare ratings are defined based on specific lumen limits per IES TM-15 Addendum A.

TABLE 501.3.6.2B (TABLE 5.3.6.2B)
MAXIMUM ALLOWABLE BACKLIGHT, UPLIGHT, AND GLARE (BUG) RATINGS[a,b,c,d]

	LZ0	LZ1	LZ2	LZ3	
Allowed Backlight Rating					
> 2 mounting heights from property line	B1	B3	B4	B5	
1 to 2 mounting heights from property line	B1	B1	B2	B3	
0.5 to 1 mounting height to property line	B0	B1	B1	B2	
< 0.5 mounting height to property line	B0	B0	B0	B1	
Allowed Uplight Rating - Luminaires ≥3,500 lumens	U0	U0	U0	U0	
Allowed Uplight Rating – Luminaires <3,500 lumes	U0	U0	U1	U2	
Allowed Glare Rating	G0	G1	G2	G3	

a. Except where installed on a building surface, luminaires that are located at a distance of two times the mounting height of the luminaire or less from a property line shall have the backlight of the luminaire aimed toward and perpendicular to the nearest property line. Backlight is that part of the luminaire's lumen output that was used to determine the backlight rating in its final angular position.
b. For property lines that abut public walkways, bikeways, plazas, and parking lots, the property line may be considered to be 5 ft (1.5 m) beyond the actual property line for the purpose of determining compliance with this section. For property lines that abut public roadways and public transit corridors, the property line may be considered to be the centerline of the public roadway or public transit corridor for the purpose of determining compliance with this section.
c. If the luminaire is installed in other than the intended manner, or is an adjustable luminaire for which the aiming is specified, the rating shall be determined by the actual photometric geometry in the aimed orientation.
d. Backlight, uplight, and glare ratings are defined based on specific lumen limits per IES TM-15 Addendum A.

TABLE 501.3.6.3 (TABLE 5.3.6.3)
MAXIMUM ALLOWABLE UPLIGHT FOR FAÇADE LIGHTING

	LZ0	LZ1	LZ2	LZ3	
Total fixture lumens per square foot of façade used for façade lighting that is allowed to be emitted above 90 degrees or higher from nadir (straight down)	0	0	0.15	0.25	

501.3.7 (5.3.7) Mitigation of Transportation Impacts.

501.3.7.1 (5.3.7.1) Pedestrian and Bicycle Connectiv- ity.

501.3.7.1.1 (5.3.7.1.1) Pedestrian Walkways. Each *primary building entrance* shall be provided with a pedestrian walkway that extends to either a *public way* or a transit stop. Walkways shall not be less than 5 ft (1.5 m) in width and shall be clearly delin- eated.

A public-use walkway shall be provided along the length of the adjoining public-way frontage of the *building project site*, and such walkways shall connect to adjacent public-use walkways.

501.3.7.1.2 (5.3.7.1.2) Bicycle Paths. On-site bicycle paths shall be designed to connect bicycle parking areas to existing and planned off-site bicycle paths adjacent to the *building project*.

501.3.7.2 (5.3.7.2) Bicycle Parking.

501.3.7.2.1 (5.3.7.2.1) Minimum Number of Spaces. Bicycle parking *spaces* shall be provided for at least 5% of the *occupant load* of each building but not less than two parking *spaces*. Occupants who are nonambulatory, under restraint, or under custodial care need not be included in the total *occupant load* for the building. *Building projects* with *dwelling units* shall be provided with at least 0.5 bicycle parking *spaces* per bedroom for each building but not less than two parking *spaces*.

Exceptions:

1. *Building projects* with *dwelling units* that provide each unit with a private garage or private, locked storage *space* of sufficient size to store a bicycle.
2. The number of bicycle parking *spaces* shall be allowed to be reduced subject to *AHJ* approval of a transportation plan, prepared by a *design professional*, that demonstrates the likelihood that building occupants will use public transportation and/or walk to the *building project site*.

501.3.7.2.2 (5.3.7.2.2) Location. Not fewer than two bicycle parking *spaces* shall be located within 50 ft (15.2 m) of, and be visible from, the *building entrance* being served. All other bicycle parking *spaces* shall be located inside the building, or the nearest point of the bicycle parking areas shall be within 50 ft (15.2 m) of the *building entrance* being served. Bicycle parking shall not obstruct pedestrian access to the building.

501.3.7.2.3 (5.3.7.2.3) Horizontal Parking Racks. Horizontal bicycle parking racks shall provide a *space* for each bicycle that is not less than 18 in. (305 mm) in width and not less than 72 in. (1829 mm) in length. Each *space* shall provide at least two points of contact between the bicycle frame and

rack. Each *space* shall have access to a clear exit pathway not less than 36 in. (914 mm) in width.

501.3.7.2.4 (5.3.7.2.4) Ability to Lock. Each bicy- cle parking *space* shall be provided with a securely mounted rack or other facilities for locking or secur- ing a bicycle. A rack shall allow the locking of the frame and the front or rear wheel of the bicycle to the rack using a U-shaped shackle lock.

501.3.7.2.5 (5.3.7.2.5) Security and Visibility. All bicycle parking *spaces* shall be visible from the entrance being served; secured in a locker, cage, or room; or provided with valet service or security cameras. Signage shall be provided to identify park- ing that is not visible from the *building entrance*.

501.3.7.2.6 (5.3.7.2.6) Documentation. *Construc- tion documents* shall include plans and details show- ing compliance with Sections 501.3.7.2.1 (5.3.7.2.1) through 501.3.7.2.5 (5.3.7.2.5).

501.3.7.3 **(5.3.7.3) Electric Vehicle Charging Provisions.** The building shall be provided with electric charging in accordance with this section and the *National Electrical Code* (NFPA 70). When parking spaces are added or modified without an increase in building size, only the new parking spaces are subject to this requirement.

a. **501.3.7.3.1 (5.3.7.3.1) Provisions for electric-vehicle charging .** The *building project* shall be provided with *electric vehicle* charging in accordance with Table 501.3.7.3 (5.3.7.3). Calculations for the number of spaces shall be rounded up to the nearest whole number. All *EVSE Installed*, *EV Ready* and *EV Capable* Spaces are to be included in the calculation for the number of minimum vehicle spaces required, as provided by the applicable article of the Denver Zoning Code.

~~1.~~

TABLE 501.3.7.3 (TABLE 5.3.7.3)
NUMBER OF EV SPACES REQUIRED

TOTAL NUMBER OF PARKING SPACES PROVIDED	Number of DC Fast Charging Spaces	NUMBER OF *EV READY SPACES*	NUMBER OF *EV CAPABLE SPACES*	NUMBER OF *EVSE INSTALLED SPACES*
1Space	None	1	None	None
2 to 9 Spaces	None	1	1	None
10 to 200 Spaces	None	10% of spaces	10% of spaces	15% of spaces
200 or more Spaces	1	20% of spaces	10% of spaces	15% of spaces

501.3.8 (5.3.8) Building Site Waste Management.

501.3.8.1 (5.3.8.1) Building Site Waste Management Plan. A building *site* waste management plan shall be developed and implemented for excavated soil, rock, and land-clearing debris. Land-clearing debris is lim- ited to tree limbs, stumps, trunks, logs and vegetation. Diverted land-clearing debris and removed rock and soil shall not be sent to *sites* where development activity is prohibited by Sec- tion 501.3.1.2 (5.3.1.2) or to *greenfields* other than those being used for agricultural purposes or being developed as part of a *building project*.

Not less than 90% of the land-clearing debris, excluding *invasive plant* materials, shall be diverted from disposal in landfills and incinerators . Land-clearing debris cal- culations shall be based on either weight or volume but not both. Receipts or other documentation related to diversion shall be maintained through the course of construction.

The plan shall address all of the following:

a. Land-clearing debris, rock, and soil to be diverted from disposal by composting, recy- cling, or reuse.

b. Waste materials that will be diverted on-site.

c. The locations to which waste materials will be diverted off-site.

d. Soils to be stockpiled for future use at any location.

e. The destruction and disposal of *invasive plant* materials.

f. The methods of removal of any contaminated soils.

g. The treatment of vegetation to comply with the rules of government-designated quarantine zones for invasive insect species.

501.3.9 (5.3.9) Soil Amendment. Soil amendment shall be applied to all permeable areas of the *site*, prior to the installation of plant material, including sod, and incorporated or rototilled to a depth of 4-6 inches.

1. All permeable areas shall apply a minimum of 4 cubic yards per 1,000 square feet of permeable areas.
    a. A minimum application rate of 12 cubic yards per 1,000 square feet is required for amended topsoil.

    Exception: Native grass seeded areas with an application rate of 2 cubic yards per 1,000 square feet of seeded area.The site must be raked smooth and finish grades must be established. Rock and debris over 1-inch in diameter that interfere with planting and maintenance operations must be removed from the site.**Exception:** Green roof plant medium and engineered stormwater quality structures where a geotechnical engineer provides recommendations on soil conditions.

CHAPTER 6

WATER USE EFFICIENCY

601.1 (6.1) Scope. This section specifies requirements for *potable water* and *nonpotable water* use efficiency, both for the *site* and for the building, and water monitoring.

601.2 (6.2) Compliance. *Building projects* shall comply with Section 601.3 in accordance with Section 101.4.1.

601.3 (6.3) Mandatory Provisions.

601.3.1 (6.3.1) Site Water Use Reduction.

The building *site* shall comply with the provisions of the following sections:

1. 601.3.1.1
2. 601.3.1.2
3. 601.3.1.3

Exception: Provide a landscape site plan that is at ten gallons per square foot or less water budget of potable water used per year. Alternatives sources of water may be substituted to increase yearly water supply, alternative sources must be calculated in conjunction and approved by Denver Water and Denver Public Works. Site plans and water budgets require the following:

a. Irrigation zones shall be based on *hydrozones* that are determined by high, medium or low water use.

b. Irrigation type including spray heads, rotors or drip, and micro spray.

c. Non potable water source contribution by zone.

d. Monthly irrigation run times by zone, post *landscape establishment period*. Irrigation run times by zones to be posted next to the irrigation controller.

e. Monthly maintenance calendar based on plant type. Monthly maintenance calendar to be posted next to the irrigation controller.

601.3.1.1 **(6.3.1.1) Landscape Design.** A minimum of 60% of the area of the *improved landscape* shall be in *biodiverse plantings* of the following approved plants:

a. Qualified trees from the Office of the City Forester approved street tree list for Denver's public rights-of-way.

b. Drought-tolerant groundcover, shrubs, and Xeric Grasses included in one of the following resources:

1. "Plant Select" qualified plants
2. "Low-Water Native Plants for Colorado Gardens" as published by the Colorado Native Plant Society
3. Xeric grasses that appear in the most recent version of the Urban Storm Drainage Criteria Manual as published by Urban Drainage and Flood Control District.

Exceptions:

1. The area of dedicated athletic fields, golf courses, driving ranges, and areas dedicated for production of food for human consumption, shall be excluded from the calculation of the *improved landscape* for schools, *residential* common areas, or public recreational facilities.
2. Landscape areas irrigated solely with *alter- nate on-site sources of water* shall be exempt from these requirements.

601.3.1.2 (6.3.1.2) Irrigation. For golf courses and driving ranges within .25 miles of Denver Water's recycled water system, only municipally reclaimed water or *alternate on-site sources of water* shall be used to irri–gate the landscape. For other landscaped areas, not greater than one-third of *improved landscape* area is allowed to be irrigated with *potable water*. The area of dedicated athletic fields shall be excluded from the cal- culation of the *improved landscape* for schools, *resi- dential* common areas, and public recreational facilities. All other irrigation shall be provided from *alternate on-site sources of water* or municipally reclaimed water.

Exception: *Potable water* is allowed to be tempo- rarily used on such newly installed landscape for the *landscape establishment period*. The amount of *potable water* allowed to be applied to the newly planted areas during the temporary *landscape establishment period* shall not exceed 70% of ET_o for *turf- grass* and 55% of ET_o for other plantings. Where municipally reclaimed water is available at a water main within .25 miles of the project *site*, such water shall be used instead of *potable water* during the *landscape establishment period*. After the *land- scape establishment period* has expired, all irrigation water use shall comply with the requirements established elsewhere in this code.

601.3.1.2.1 (6.3.1.2.1) Irrigation System Design. The design of the irrigation system shall be performed by a Certified Landscape Irrigation Auditor (CLIA), Qualified Water Efficient Landscaper (QWEL) or other accredited or certified irriga–tion professional and

shall be in accordance with the following:

a. Irrigation systems:
    1. Shall be based on *hydrozones*. *Turfgrass* areas shall be on their own *irrigation* zones.
    2. Shall have backflow prevention in accordance with the plumbing code (**Informative note:** e.g., *International Plumbing Code*).
    3. Shall have a master valve on municipally supplied water sources that allows pressurization of the irrigation mainline only when irrigation is scheduled.
    4. Shall have a flow sensor and monitoring equipment that will shut off the control valve if the flow exceeds normal flow from an *irrigation station*.
    5. Shall prevent piping from draining between irrigation events.
b. Irrigation emission devices shall comply with ASABE/ICC 802, *Landscape Irrigation Sprinkler and Emitter Standard*.
c. Irrigation sprinklers:
    1. Shall not spray water directly on buildings or *hardscape* area.
    2. Shall have matched precipitation rate nozzles within an *irrigation station*.
    3. Shall be prohibited on landscape areas having any dimension less than 4 ft (1220 mm).
    4. Shall have an application rate less than or equal to 0.75 in. (19 mm) per hour on slopes greater than 1 unit vertical in 4 units horizontal.
    5. Shall be limited to use with *turfgrass* or *ground cover* areas with vegetation maintained at 8 in. (203 mm) or less in height.
    6. Where of the pop-up configuration, shall have a pop-up height of not less than 4 in (100 mm).

TABLE 601.3.2.1 (TABLE 6.3.2.1)
PLUMBING FIXTURES AND FITTINGS
REQUIREMENTS

PLUMBING FIXTURE	MAXIMUM
Water closets (toilets)—flushometer single-flush valve type	Single-flush volume of 1.1 gal
Water closets (toilets)—flushometer dual-flush valve type	Full-flush volume of 1.1 gal
Water closets (toilets)—single-flush tank-type	Single-flush volume of 1.1gal
Water closets (toilets)—dual-flush tank-type	Full-flush volume of 1.1 gal
Urinals	Flush volume 0.125 gal
Public lavatory faucets	Flow rate—0.5 gpm (1.9 L/min)
Public metering self-closing faucet	0.25 gal (1.0 L) per metering cycle
Residential bathroom lavatory sink faucets	Flow rate— 1.2 gpm
Residential kitchen faucets	Flow rate—1.8 gpm (6.8 L/min) [a]
Residential showerheads	Flow rate—1.8 gpm
Residential shower compartment (stall) in *dwelling units* and guest rooms	Flow rate from all shower outlets total of 1.8 gpm

a. With provision for a temporary override to 2.2 gpm (8.3 L/min) as specified in Section 601.3.2(g) [6.3.2.1(g)].

d. Microirrigation zones:

1. Shall be equipped with pressure regulators, filters, and flush assemblies.
2. Shall have indicators that allow confirmation of operation by visual inspection.

601.3.1.2.2 (6.3.1.2.2) Controls. Where any irrigation system for the project *site* uses an *automatic* controller, the system shall be controlled by a qualifying *smart controller* that uses *evapotranspiration* (*ET*) and weather data to adjust irrigation schedules and that complies with the minimum requirements. The system shall be controlled by weather-based data or soil moisture sensors that automatically shuts off the system after a predetermined amount of rainfall or sensed moisture in the soil. Qualifying *smart controllers* shall be labeled according to USEPA WaterSense Specification for Weather-Based Irrigation Controllers or tested in accordance with Irrigation Association SWAT Climatologically Based Controllers, 8th Testing Protocol. *Smart controllers* that use *ET* data shall provide the following irrigation amounts:

a. *Irrigation adequacy*—80% minimum ET_c.

b. *Irrigation excess*—not to exceed 10% of ET_c.

Exception: A temporary irrigation system used exclusively for the establishment of new landscape shall be exempt from this requirement. Temporary irrigation systems shall be removed or permanently disabled at such time as the *landscape establishment period* has expired.

601.3.1.2.2.1 (6.3.1.2.2.1). The following set- tings and schedule for the irrigation control system shall be posted on or adjacent to the controller:

a. Precipitation rate of each *irrigation station*.

b. *Plant* factors for each *hydrozone*.

c. Soil type.

d. Rain sensor settings.

e. Soil moisture sensor settings, where installed.

f. Peak demand schedule, including run times, cycle starts, and soak times.

g. Maximum runtimes to prevent water runoff.

601.3.1.2.3 (6.3.1.2.3) Irrigation of Drought Tolerant Plants. The use of *potable water* or *reclaimed water* for irrigation of native and *adapted plants* should be completed by the end of the third growing season and irrigation system for affected areas should be permanently disconnected and dismantled without unduly damaging plant material or root zone. All water use will be charged at the construction water rate. In-ground irrigation sys- tems for *approved drought-tolerant plants* using potable or off-site treated *reclaimed water* are prohibited.

Exception:

1. *Plants* deemed equivalent to – *drought-tolerant plants* by Section 601.3.1.1 (6.3.1.1).
2. Plants that are used on green roofs and other similar applications.

601.3.2 (6.3.2) Building Water Use Reduction.

601.3.2.1 (6.3.2.1) Plumbing Fixtures and Fittings. Plumbing fixtures (water closets and urinals) and fit-

tings (faucets and showerheads) shall comply with the following requirements, as shown in Table 601.3.2.1 (6.3.2.1):

a. **Water closets (toilets)—flushometer valve type.** For single-flush, maximum flush volume shall be determined in accordance with ASME A112.19.2/CSA B45.1 and shall not exceed 1.1 gal . For dual-flush, the full-flush volume shall not exceed 1.1 gal per flush. Dual- flush fixtures shall also comply with the provi- sions of ASME A112.19.14.

b. **Water closets (toilets)—tank-type.** Tank-type water closets shall be certified to the performance criteria of the USEPA WaterSense Tank-Type High-Efficiency Toilet Specification and shall have a maximum full-flush volume of 1.1 gal . Dual-flush fixtures shall also comply with the provisions of ASME A112.19.14.

c. **Urinals.** Maximum flush volume, when deter- mined in accordance with ASME A112.19.2/ CSA B45.1, shall not exceed 0.125 gal . Flushing urinals shall comply with the perfor- mance criteria of the USEPA WaterSense Speci- fication for Flushing Urinals. Nonwater urinals shall comply with ASME A112.19.19 (vitreous china) or IAPMO Z124.9 (plastic) as appropriate.

d. **Public lavatory faucets.** Maximum flow rate shall not exceed 0.25 gpm when tested in accordance with ASME A112.18.1/CSA B125.1.

e. **Public metering self-closing faucet.** Maximum water use shall not exceed 0.25 gal (1.0 L) per metering cycle when tested in accordance with ASME A112.18.1/CSA B125.1.

f. **Residential bathroom lavatory sink faucets.** Maximum flow rate shall not exceed 1.2 gpm when tested in accordance with ASME A112.18.1/CSA B125.1. *Residential* bathroom lavatory sink faucets shall comply with the performance criteria of the USEPA Water- Sense High-Efficiency Lavatory Faucet Specifi- cation.

g. **Residential kitchen faucets.** Maximum flow rate shall not exceed 1.8 gpm (6.8 L/min) when tested in accordance with ASME A112.18.1/CSA B125.1. Kitchen faucets shall be permitted to temporarily increase the flow greater than 1.8 gpm (6.8 L/min) but shall not exceed 2.2 gpm (8.3 L/min) and must automatically revert to the established maximum flow rate of 1.8 gpm (6.8 L/min) upon physical release of the activation mechanism or closure of the faucet valve.

h. **Residential showerheads.** Maximum flow rate shall not exceed 1.8 gpm when tested in accordance with ASME A112.18.1/CSA B125.1. *Residential* showerheads shall comply with the performance requirements of the USEPA WaterSense Specification for Shower- heads.

i. **Residential shower compartment (stall) in dwelling units and guest rooms.** The allowable flow rate from all shower outlets (including rain systems, waterfalls, bodysprays, and jets) that can operate simultaneously shall be limited to a total of 1.8 gpm .

Exception: Where the area of a shower com- partment exceeds 2600 in.^{2} (1.7 m^2), an addi- tional flow of 1.8gpm shall be permitted for each multiple of 2600 in.^{2} (1.7 m^2) of floor area or fraction thereof.

j. **Water-bottle filling stations.** *Water-bottle fill- ing stations* shall be an integral part of, or shall be installed adjacent to, not less than 50% of all drinking fountains installed indoors on the prem- ises.

601.3.2.2 (6.3.2.2) Appliances.

a. *Clothes washers* and *dishwashers* installed within *dwelling units* shall comply with the ENERGY STAR® Program Requirements for Clothes Washers and ENERGY STAR Program Require- ments for Dishwashers. Maximum water use shall be as follows:

1. *Clothes washers*—Maximum *water factor* (*WF*) of 5.4 gal/ft^3 of drum capacity (0.72 L/L of drum capacity) with load sensing capability.

2. Dishwashers—Standard-size dishwashers shall have a maximum *WF* of 3.5 gal/full operating cycle . Compact sizes shall have a maxi- mum *WF* of 3.5 gal/full operating cycle (13.2 L/full operating cycle). Standard and compact size shall be defined by ENERGY STAR criteria.
[See also the energy efficiency require- ments in Section 701.4.7.3 (7.4.7.3).]

b. Clothes washers installed in publicly accessible *spaces* (***Informative Note:*** e.g., multifamily and hotel common areas), and coin- and card-oper- ated clothes washers of any size used in laundro- mats, shall have a maximum *WF* of 4.0 gal/ft^3 of drum capacity normal cycle (0.53 L/L of drum capacity normal cycle). [See also the energy effi- ciency requirements in Sections 701.4.7.3 (7.4.7.3).]

c. Commercial dishwashers in commercial food- service facilities shall meet all

ENERGY STAR requirements as listed in the ENERGY STAR Program Requirements for Commercial Dishwashers, Version 2.0.

601.3.2.3 (6.3.2.3) HVAC Systems and Equipment.

a. *Once-through cooling* with *potable water* is pro- hibited.

b. The water being discharged from cooling towers for air-conditioning systems such as chilled-water systems shall be limited in accordance with method (1) or (2):

1. For makeup waters having less than 200 ppm (200 mg/L) of total hardness expressed as calcium carbonate, by achieving a minimum of 5 *cycles of concentration*.
2. For makeup waters with more than 200 ppm (200 mg/L) of total hardness expressed as calcium carbonate, by achieving a minimum of 3.5 *cycles of concentration*.

Exception: Where the total dissolved solids concentration of the discharge water exceeds 1500 mg (1500 ppm/L) or the silica exceeds 150 ppm (150 mg/L) measured as silicon dioxide before the above *cycles of concentration* are reached.

c. Cooling towers and evaporative coolers shall be equipped with makeup and blowdown meters, conductivity controllers, and overflow alarms in accordance with the thresholds listed in Table 601.3.4.1B (6.3.4.1B). Cooling towers shall be equipped with efficient drift eliminators that achieve drift reduction to a maximum of 0.002% of the recirculated water volume for counterflow towers and 0.005% of the recirculated water flow for cross-flow towers.

601.3.2.4 (6.3.2.4) Roofs.

a. The use of *potable water* or *reclaimed water* for *roof* spray systems to thermally condition the *roof* shall be prohibited.

Exception: Where approved by the *authority having jurisdiction* (*AHJ*), on-site treated *reclaimed water* may be used for *roof* spray systems.

b. In-ground irrigation systems on vegetated *roofs* using potable or off-site treated *reclaimed water* shall not exceed 10 gallons per square foot of vegetated roof area per year and shall be either a drip or spray type irrigation system.

601.3.2.5 (6.3.2.5) Commercial Food Service Opera- tions. Commercial food service operations (***Informa- tive Note:*** e.g., restaurants, cafeterias, food preparation kitchens, caterers, etc.):

a. Shall use high-efficiency prerinse spray valves (i.e., valves that function at 1.3 gpm [4.9 L/min] or less and comply with a 26 second performance requirement when tested in accordance with ASTM F2324),

b. Shall use dishwashers that comply with the requirements of the ENERGY STAR Program for Commercial Dishwashers,

c. Shall use boilerless/connectionless food steamers that consume no more than 2.0 gal/h (7.5 L/h) in the full operational mode,

d. Shall use combination ovens that consume not more than 10 gal/h (38 L/h) in the full operational mode,

e. Shall use air-cooled ice machines that comply with the requirements of the ENERGY STAR Program for Commercial Ice Machines, and

f. Shall use dipper wells equipped with an in-line flow restrictor limiting flow to 0.3 gpm. .

601.3.2.6 (6.3.2.6) Medical and Laboratory Facili- ties. Medical and laboratory facilities, including clinics, hospitals, medical centers, physician and dental offices, and medical and nonmedical laboratories of all types shall:

a. Use only water-efficient steam sterilizers equipped with (1) water-tempering devices that allow water to flow only when the discharge of condensate or hot water from the sterilizer exceeds 140°F (60°C) and (2) mechanical vac- uum equipment in place of venturi-type vacuum systems for vacuum sterilizers.

b. Use film processor water-recycling units where large-frame x-ray films of more than 6 in. (150 mm) in either length or width are processed. Small dental x-ray equipment is exempt from this requirement.

c. Use digital imaging and radiography systems where the digital networks are installed.

d. Use a dry-hood scrubber system or, if the appli- cant determines that a wet-hood scrubber system is required, the scrubber shall be equipped with a

water recirculation system. For perchlorate hoods and other applications where a hood wash-down system is required, the hood shall be equipped with self-closing valves on those wash-down systems.

e. Use only dry vacuum pumps unless fire and safety codes (**Informative Note:** e.g., *International Fire Code*) for explosive, corrosive, or oxidative gases require a liquid ring pump.

f. Use only efficient water treatment systems that comply with the following criteria:

1. For all filtration processes, pressure gages shall determine and display when to backwash or change cartridges.

2. For all ion exchange and softening processes, recharge cycles shall be set by volume of water treated or based on conductivity or hardness.

3. For reverse osmosis and nanofiltration equipment with capacity greater than 27 gal/h (100 L/h), reject water shall not exceed 60% of the feed water and shall be used as scrubber feed water or for other beneficial uses on the project *site*.

4. Simple distillation is not acceptable as a means of water purification.

g. With regard to food service operations within medical facilities, comply with Section 601.3.2.5 (6.3.2.5).

601.3.3 (6.3.3) Special Water Features. Water use shall comply with the following:

a. Ornamental fountains and other ornamental water features shall be supplied either by *alternate on-site sources of water* or by municipally reclaimed water delivered by the local water utility acceptable to the *AHJ*. Fountains and other features equipped with *automatic* water refilling valves shall be equipped with (1) makeup water meters that are connected to a Building Management System (BMS) if such a system is included in the *building project* (2) leak detection devices that shut off water flow if a leak of more than 1.0 gal/h (3.8 L/h) is detected, and (3) equip- ment to recirculate, filter, and treat all water for reuse within the system.

Exception: Where *alternate on-site sources of water* or municipally reclaimed water are not available within 500 ft (150 m) of the *building project site*, *potable water* is allowed to be used for water features with less than 10,000 gal (38,000 L) capacity.

b. Pools and spas:

1. Recover filter backwash water for reuse on landscaping or other applications, or treat and reuse backwash water within the system.

2. For filters with removable cartridges, only reusable cartridges and systems shall be used. For filters with backwash capability, use only pool filter equipment that includes a pressure

drop gage to determine when the filter needs to be backwashed and a sight glass enabling the operator to determine when to stop the backwash cycle.

3. Pool splash troughs, if provided, shall drain back into the pool system.

601.3.4 (6.3.4) Water Consumption Measurement.

601.3.4.1 (6.3.4.1) Consumption Management. Mea- surement devices with remote communication capabil- ity shall be provided to collect water consumption data for the domestic water supply to the building and on all water sources used in tenant spaces and any individual water end uses that represents 10% or more the total annual consumption of the tenant space. Both potable and *reclaimed water* entering the *building proj- ect* shall be monitored or submetered. In addition, for individual leased, rented, or other tenant or subtenant *space* within any building totaling in excess of 50,000 ft^2 (5000 m^2), separate submeters shall be provided. For subsystems with multiple similar units, such as multi- cell cooling towers, only one measurement device is required for the subsystem. Any project or building, or tenant or subtenant *space* within a project or building, such as a commercial car wash or aquarium, shall be submetered where consumption is projected to exceed 1000 gal/day (3800 L/day).

Measurement devices with remote capability shall be provided to collect water use data for each water supply source (***Informative Note:*** e.g., *potable water*, *reclaimed water*, rainwater) to the *building project* that exceeds the thresholds listed in Table 601.3.4.1A (6.3.4.1A). Utility company service entrance/interval meters are allowed to be used.

Provide submetering with remote communication measurement to collect water use data for each of the building subsystems if such subsystems are sized above the threshold levels listed in Table 601.3.4.1B (6.3.4.1B).

601.3.4.2 (6.3.4.2) Consumption Data Collection. All building measurement devices, monitoring systems, and submeters shall be permanently installed and comply with the threshold limits in Section 601.3.4.1 (6.3.4.1) shall be configured to communicate water consumption data to a meter data management system. At a minimum, meters shall pro- vide daily data and shall record hourly consumption of water.

601.3.4.3 (6.3.4.3) Data Storage and Retrieval. The meter data management system shall be connected to a local area network capable of transmitting data to a remote location and of electronically storing water meter, monitoring systems, and submeter data for a least 36 months. The data management system shall be capable of creating user reports showing calculated hourly, daily, monthly, and annual water consumption for each measurement device and subme- ter and provide alarm notification capabilities as needed to support the requirements of the water user efficiency plan for operation in Section 1001.3.2.1.2 (10.3.2.1.2).

(6.3.5) Reserved

TABLE 601.3.4.1A (TABLE 6.3.4.1A)
WATER SUPPLY SOURCE MEASUREMENT THRESHOLDS

WATER SOURCE	MAIN MEASUREMENT THRESHOLD
Potable water	1000 gal/day (3800 L/day)
Municipally *reclaimed water*	1000 gal/day (3800 L/day)
Alternate sources of water	500 gal/day (1900 L/day)

TABLE 601.3.4.1B (TABLE 6.3.4.1B) SUBSYSTEM WATER MEASUREMENT THRESHOLDS

SUBSYSTEM	SUBMETERING THRESHOLD
Cooling towers (meter on makeup water and blowdown)	Cooling tower flow through tower > 500 gpm (30 L/s)
Evaporative coolers	Makeup water > 0.6 gpm (0.04 L/s)
Steam and hot-water boilers	> 500,000 Btu/h (150 kW) input
Total irrigated landscape area with controllers	> 25,000 ft^2 (2500 m^2)
Separate campus or project buildings	Consumption > 1000 gal/day (3800 L/day)
Separately leased or rental *space*	Consumption > 1000 gal/day (3800 L/day)
Any large water-using process	Consumption > 1000 gal/day (3800 L/day)
Tenant Spaces	Consumption > 10% of the total annual consumption of that space

601.3.5 (6.3.6) Reverse Osmosis Water Treatment Sys- tems. Reverse osmosis systems shall be equipped with an *automatic* shutoff valve that prevents the production of reject water when there is no demand for treated water. Point-of-use reverse osmosis treatment systems for drink- ing water shall be listed and labeled in accordance with NSF 58.

601.3.6 (6.3.7) On-Site Reclaimed Water Treatment Systems. On-site reclaimed water treatment systems, including grey water reuse treatment systems and waste water treatment systems, used to produce *nonpotable water* for use in water closet and urinal flushing, surface irrigation, and similar applications shall be listed and labeled in accordance with NSF 350.

601.3.7 (6.3.8) Dual Water Supply Plumbing.

601.3.7.1 (6.3.8.1) Where sufficient supply of *reclaimed water* or *alternate on-site sources of water* is within .25 miles of Denver Water's recycle water system, or planned to be available, within five years of completed building construction, the water supply system within the building shall be installed to allow the supply of reclaimed or alternative water to all uri–nals and water closets pending a final review by Denver Water.

Exceptions:

1. Existing buildings under renovation, where the water supply to the urinals and water clos–ets within the building is to remain intact, shall not be required to supply *nonpotable water* to urinals and water closets.
2. Urinals and water closets designed to operate without the use of water shall not be required to have alternate or reclaimed water supply to the fixture.

CHAPTER 7

ENERGY EFFICIENCY

701.1 (7.1) Scope. This section specifies requirements for energy efficiency for buildings and appliances, for *on-site renewable energy systems*, and for energy measuring.

701.2 (7.2) Compliance. The energy systems shall comply with Section 701.3 (7.3), "Mandatory Provisions" in accordance with Section 101.4.1, and one of the following:

a. Section 701.4 (7.4), "Prescriptive Option," or

b. Section 701.5 (7.5), "Performance Option" or

c. Section 701.6 (7.6), "Zero Net Energy Option," or

d. Section 701.7 (7.7), "Passive House Option."

701.3 (7.3) Mandatory Provisions.

701.3.1 (7.3.1) General. *Building projects* shall be designed to comply with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408 of the *International Energy Conservation Code* (IECC).

701.3.1.1 (7.3.1.1) Continuous Air Barrier. Building envelope airtightness shall comply with the IECC, Section C402.5.1.2.3, with the following modifications and additions:

1. The measured air leakage rate of the building envelope shall not exceed 0.25 cfm/ft2 (1.25 L/s·m2) under a pressure differential of 0.3 in. of water (75 Pa), with this air leakage rate normalized by the sum of the above- and below-grade building envelope areas of the conditioned and semiheated space.
2. The exception to C402.5.1.2.3 is allowed where the measured air leakage rate exceeds 0.25 cfm/ft2 (1.25 L/s·m2) but does not exceed 0.40 cfm/ft2 (2.0 L/s·m2).

701.3.2 (7.3.2) On-Site Renewable Energy Systems. *Building project* design shall show allocated *space* and pathways for future installation of *on-site renewable energy systems* and associated infrastructure that provide the annual energy production equivalent of not less than 4.0 kBtu/ft^2 (20 kWh/m^2) for single-story buildings and not less than 7.0 kBtu/ft^2 (32 kWh/m^2) multiplied by the *gross roof area* in feet squared (metres squared) for all other buildings in addition to any *on-site renewable* production used to comply with C406 of the IECC.

Exceptions:

1. *Building projects* that have an annual daily average incident solar radiation available to a flat plate collector oriented due south at an angle from horizontal equal to the latitude of the collector location less than 1.2 kBtu/ft^2·day (4.0 kWh/m^2·day), accounting for existing buildings, permanent infrastructure that is not part of the *building project*, topography, or trees.
2. *Building projects* that comply with Section 701.4.1.1 (7.4.1.1).

701.3.3 (7.3.3) Energy Consumption Management.

701.3.3.1 (7.3.3.1) Consumption Management. Mea- surement devices with remote communication capabil- ity shall be provided to collect energy consumption data for each energy supply source to the building (including gas, electricity, and district energy) that exceeds the thresholds listed in Table 701.3.3.1A (7.3.3.1A). The measurement devices shall have the capability to automatically communicate the energy consumption data to a data acquisition system.

For all buildings that exceed the threshold in Table 701.3.3.1A (7.3.3.1A), subsystem measurement

devices with remote capability (including current sen- sors or flowmeters) shall be provided to measure energy consumption data of each subsystem for each use category that exceeds the thresholds listed in Table 701.3.3.1B (7.3.3.1B).

The energy consumption data from the subsystem measurement devices shall be automatically communi- cated to the data acquisition system.

TABLE 701.3.3.1A (TABLE 7.3.3.1A) ENERGY SOURCE THRESHOLDS

ENERGY SOURCE	THRESHOLD
Electrical service	> 200 kVA
On-site renewable electric power	All systems > 1 kVA (peak)
Gas and district services	> 1,000,000 Btu/h (300 kW)
Geothermal energy	> 1,000,000 Btu/h (300 kW) heating
On-site renewable thermal energy	> 100,000 Btu/h (30 kW)

TABLE 701.3.3.1B (TABLE 7.3.3.1B) SYSTEM ENERGY USE THRESHOLDS

USE (TOTAL OF ALL LOADS)	SUBSYSTEM THRESHOLD
HVAC system	Connected electric load > 100kVA
	Connected gas or district services load > 500,000 Btu/h (150 kW)
People moving	Sum of all feeders > 50 kVA
Lighting	Connected load > 50 kVA
Process and plug process	Connected load > 50 kVA
	Connected gas or district services load > 250,000 Btu/h (75 kW)

701.3.3.2 (7.3.3.2) Energy Consumption Data Col- lection and Display. All building measurement devices shall be configured to automatically communicate the energy data to the data acquisition system. Measure- ment devices shall provide daily data and shall record hourly energy profiles. Such hourly energy profiles shall be capable of being used to assess building perfor- mance at least monthly. The hourly energy profiles shall be displayed.

701.3.3.3 (7.3.3.3) Data Storage and Retrieval. The data acquisition system shall be capable of electroni- cally storing the data from the measurement devices and other sensing devices for a minimum of 36 months and creating user reports showing hourly, daily, monthly, and annual energy consumption.

Exception: Portions of buildings used as *residen- tial.*

701.3.4 **(7.3.4) Demand Response.** *Building projects* shall contain control systems that have

the capability to reduce building equipment loads to lower electric peak demand of the building.

The building controls shall be designed with demand-response (DR) infrastructure capable of receiving DR requests from the utility, electrical system operator, or third-party DR program provider and imple- menting load adjustments to the HVAC and lighting sys- tems.

701.3.4.1 (7.3.4.1) HVAC Systems Zone Set Points. *The building project's* HVAC systems shall be programmed to allow centralized demand reduction in response to a signal from a centralized contact or software point in accordance with the following:

a. The controls shall be programmed to adjust upward the zone operating cooling set points by a minimum of 3°F (1.7°C).

b. The controls shall programmed to adjust downward the zone operating heating set points by a minimum of 3°F (1.7°C).

c. The controls shall be programmed to adjust downward the zone operating cooling set points by a minimum of 2°F (1.1°C).

d. The DR strategy shall include both ramp-up and ramp-down logic to prevent the building peak demand from exceeding that expected without the DR implementation.

Exception: Systems serving areas deemed by the *owner* to be critical in nature.

701.3.4.2 (7.3.4.2) Variable-Speed Equipment. For HVAC equipment with variable-speed control, the controls shall be programmed to allow adjust- ment of the maximum speed of the equipment to 90% of design speed during DR events. Airflow adjustments shall not decrease the supply airflow rate below the level that would result in outdoor airflow being below the *minimum outdoor airflow rates* speci- fied in Section 801.3.1.1 (8.3.1.1), or that would cause adverse building pressurization problems.

701.3.4.3 (7.3.4.3) Lighting. For *building projects* with interior lighting control systems controlled at a central point, such systems shall be programmed to allow DR. The programming shall reduce the total connected lighting power demand during a DR event by not less than 15% but no more than 50% of the base- line power level. The baseline lighting power shall be determined in accordance with Section 701.4.6.1.1 (7.4.6.1.1). For *building projects* without central light- ing controls, DR capabilities for lighting systems shall not be required.

For *spaces* not in the *daylight area* and not connected to automated daylighting control, the lighting levels shall be uniformly reduced throughout the *space*.

Exceptions:

1. Luminaires or signage on emergency circuits.
2. Luminaires located within a *daylight area* that are dimmable and connected to automated daylighting control systems.
3. Lighting systems, including dimming systems, claiming a *lighting power allowance* for *insti- tutional tuning* in accordance with Section 701.4.6.1.1(f) [7.4.6.1.1(f)].

701.4 (7.4) Prescriptive Option.

701.4.1 (7.4.1) General Comprehensive Prescriptive Requirements. When a requirement is provided below, it supersedes the requirement in the *International Energy Conservation Code* (IECC). For all other criteria, the *building project* shall comply with the requirements of the *International Energy Conservation Code* (IECC).

(7.4.1.1) Renewables Approach: Baseline On-Site Renewable Energy Systems. *Building projects* shall contain *on-site renewable energy systems* that provide the annual energy production equivalent of not less than 4.0 kBtu/ft^2 (20 kWh/m^2) multiplied by the horizon- tal projection of the *gross roof area* in feet squared (metres squared) for single-story buildings, and not less than 7.0 kBtu/ft^2 (32 kWh/m^2) multiplied by the horizontal projection of the *gross roof area* in feet squared (metres squared) for all other buildings. The annual energy production shall be the combined sum of all *on-site renewable energy systems*. Documentation shall be provided to the *AHJ* that indicates that the *renewable energy certificates* (*RECs*) associated with the *on-site renewable energy system* will be retained and retired by the *owner*. Where the building *owner* does not have ownership of the *RECs* associated with the *on-site renewable energy system*, the *owner* shall obtain and retire an equal or greater quantity of *RECs*.

Exceptions: Buildings that demonstrate compli- ance with both of the following are not required to contain *on-site renewable energy systems*:

1. An annual daily average incident solar radi- ation available to a flat plate collector ori- ented due south at an angle from horizontal equal to the latitude of the collector location less than 4.0 kWh/m^2·day (1.2 kBtu/ft^2/ day), accounting for existing buildings, permanent infrastructure that is not part of the *building project*, topography, and

trees.

2. A commitment to purchase renewable electricity products complying with the Green- e Energy National Standard for Renewable Electricity Products, of at least 7 kWh/ft^2 (75 kWh/m^2) of *conditioned space* each year until the cumulative purchase totals 70

kWh/ft^2 (750 kWh/m^2) of *conditioned space*.

(7.4.2) Building Envelope. The *building envelope* shall comply with the requirements in the IECC, Table C402.1.4, with the following modifications to values in the table.

For the opaque elements, each U-factor, C-factor, and F-factor in the table shall be reduced by 5%. For *vertical curtain walls, storefront and site-built fenestration products* and *skylights*, each U-factor in the IECC, Table C402.4, shall be reduced by 10%. For all other vertical *fenestration* and *skylights*, each U-factor in the IECC, Table C402.4, shall be reduced by 5%. For *skylights* and east-oriented and west-oriented *vertical fenestration*, each *solar heat gain coefficient* (*SHGC*) in the IECC, Table C402.4, shall be reduced by 5%. These adjustments shall also be applicable where the intent is to comply with the component performance alternative of the IECC, Section C402.1.5.

Exceptions:

1. The U-factor, C-factor, or F-factor shall not be modified where the corresponding R-value requirement is designated as "NR" (no requirement) in the IECC, Table C402.4.
2. The *SHGC* shall not be modified where the *SHGC* requirement is designated as "NR" (no requirement) in the IECC, Table C402.4.
3. *Spaces* that meet the requirements of Section 801.4.1 (8.4.1), regardless of *space* area, are exempt from the *SHGC* criteria for *skylights*.

Notes:

1. U-factors, C-factors, and F-factors for many common assemblies are provided in ANSI/ ASHRAE/ IES Standard 90.1, Normative Appen- dix A.
2. Section 501.3.5.3 (5.3.5.3) includes additional provisions related to *roofs*.

701.4.1.1 (7.4.2.1) Reserved. (7.4.2.2) Single-Rafter Roof Insulation. *Single-rafter roofs* shall comply with the requirements in Normative Appendix A, Table A101.1 (A-1). These requirements supersede the requirements in the IECC, Tables C402.1.3 and C402.1.4.

701.4.1.2 (7.4.2.3) High-Speed Doors. *High-speed doors* that are intended to operate on average at least 75 cycles per day shall not exceed a maximum U-factor of 1.20 Btu/h·ft^2·°F (6.81 W/m^2·K). Opening rate, closing rate, and average cycles per day shall be included in construction drawings. IECC, Table C402.1.3, shall not apply for *high-speed doors* complying with all criteria in this section.

701.4.2.4 (7.4.2.4) RESERVED

701.4.2.5 (7.4.2.5) Vertical Fenestration Area. *Vertical fenestration area* shall comply with the IECC, Sections C402.4.1 and C402.4.1.1.

(7.4.2.7) SHGC of Vertical Fenestration. The SHGC of *vertical fenestration* shall comply with Table C402.4 provided the SHGC multipliers in Table 701.4.2.7 (TABLE 7.4.2.7) are used.

TABLE 701.4.2.7 (TABLE 7.4.2.7)
SHGC MULTIPLIERS FOR PERMANENT PROJECTIONS

SHGC MULTIPLIER	
(ALL OTHER ORIENTATIONS)	(NORTH-ORIENTED)
0.80	0.95

labeled VT no less than 0.40.

b. A manual override located in the same *enclosed space* as the *vertical fenestra-*

(7.4.2.8) Building Envelope Trade-Off Option. The *building envelope* component performance alternative of the IECC, Section C402.1.5, shall not apply unless the procedure incorporates the modifications and additions to the IECC noted in Section 701.4.2 (7.4.2).

701.4.2.8 (7.4.2.9) Orientation. The *vertical fenestra- tion* shall comply with either (a) or (b):

a. $A_W \leq (A_N + A_S)/4$ and $A_E \leq (A_N + A_S)/4$

b. $A_W \times SHGC_W \leq (A_N \times SHGC_C + A_S \times SHGC_C)/6$ and $A_E \times SHGC_E \leq (A_N \times SHGC_C + A_S \times SHGC_C)/6$

where:

$SHGC_x$ = the *SHGC* for orientation *x* that complies with Section 701.4.2.7 (7.4.2.7).

$SHGC_C$ = the *SHGC* criteria for each *climate zone* from Section 701.4.2.1 (7.4.2.1).

A_x = *fenestration area* for orientation *x*.

N = north (oriented less than 45 degrees of true north).

S = south (oriented less than 45 degrees of true south).

E = east (oriented less than or equal to 45 degrees of true east).

W = west (oriented less than or equal to 45 degrees of true west).

Exceptions:

1. Buildings with shade on 75% of the west- and east-oriented *vertical fenestration areas* from permanent projections, existing buildings, existing permanent infrastructure, or topography at 9 a.m. and 3 p.m. on the summer solstice (June 21 in the northern hemisphere).
2. Alterations and additions with no increase in *vertical fenestration area*.
3. Buildings where the west- and east-oriented *vertical fenestration areas* do not exceed 20% of the *gross wall area* for each of those façades, and the *SHGC* on those façades is not greater than 90% of the criteria in Section 701.4.2.1 (7.4.2.1).

701.4.3 (7.4.3) Heating, Ventilating, and Air Conditioning. The heating, ventilating, and air conditioning shall comply with the IECC, Sections C301 and C403, with the following modifications and additions.

701.4.3.1 (7.4.3.1) Minimum Equipment Efficiencies . All *building projects* shall comply with the applicable equipment efficiency requirements in Normative Appendix B and the applica- ble ENERGY STAR requirements in Section 701.4.7.3.2 (7.4.7.3.2). Where equipment efficiency is not defined/listed in Normative Appendix B or in Sec- tion 701.4.7.3.2 (7.4.7.3.2), the equipment shall meet the minimum efficiency requirements defined/listed in ANSI/ASHRAE/IES Standard 90.1. Specifically, this applies to the following products in ANSI/ASHRAE/IES Standard 90.1:

a. Table 6.8.1.3, "Water-Chilling Packages—Minimum Efficiency Requirements."
b. Table 6.8.1-11, "Air Conditioners and Condensing Units Serving Computer Rooms—Minimum Efficiency Requirements."
c. Table 6.8.1-12, "Commercial Refrigerator and Freezers—Minimum Efficiency Requirements."
d. Table 6.8.1-13, "Commercial Refrigeration—Minimum Efficiency Requirements."
e. Table 6.8.1-14, "Vapor Compression Based Indoor Pool Dehumidifiers—Minimum Effi- ciency Requirements."
f. Table 6.8.1-15, "Electrically Operated DX- DOAS Units, Single-Package and Remote Con- denser, without Energy Recovery—Minimum Efficiency Requirements."
g. Table 6.8.1-16, "Electrically Operated DX- DOAS Units, Single Package and Remote Con- denser, with Energy Recovery—Minimum Effi- ciency Requirements."
h. Table 10.8-1, "Minimum Nominal Full-Load Efficiency for NEMA Design A, NEMA Design B, and IEC Design N Motors (Excluding Fire Pump Electric Motors) at 60 Hz" (NEMA MG 1).
i. Table 10.8-2, "Minimum Nominal Full-Load Efficiency for NEMA Design C and IEC Design H Motors at 60 Hz" (NEMA MG 1).
j. Table 10.8-3, "Minimum Average Full-Load Efficiency for Polyphase Small Electric Motors."
k. Table 10.8-4, "Minimum Average Full-Load Efficiency for Capacitor-Start Capacitor-Run and Capacitor-Start Induction-Run Small Electric Motors."
l. Table 10.8-5, "Minimum Nominal Full-Load Efficiency for Fire Pump Electric Motors."

701.4.3.1.1 (7.4.3.1.1) Water-Cooled Centrifugal Chiller Packages Efficiency Adjustment.

a. **For Water-Cooled Centrifugal Units Rated per AHRI Standard 550/590 (I-P).** Equip- ment not designed for operation at AHRI Standard 550/590 test conditions of 44.00°F leaving and 54.00°F entering chilled-fluid temperatures, and with 85.00°F entering and 94.30°F leaving condenser-fluid temperatures, shall have maximum full-load (FL) kW/ton and part-load rating requirements adjusted using the following equations:

$FL_{adj} =$

FL/K_{adj}

$PLV_{adj} =$

$IPLV/K_{adj}$

$K_{adj} = A \times$

B where:

FL = full-load kW/ton value from ANSI/ASHRAE/IES Standard 90.1, Table 6.8.1-3.

FL_{adj} = maximum full-load kW/ton rating, adjusted for nonstandard conditions.

IPLV = IPLV value from ANSI/ASHRAE/IES Standard 90.1, Table 6.8.1-3.

PLV_{adj} = maximum *NPLV* rating, adjusted for nonstandard conditions.

A = $0.000000145920 \times (\text{LIFT})^4 - 0.0000346496 \times (\text{LIFT})^3 + 0.00314196 \times (\text{LIFT})^2 0.147199 \times (\overline{\text{LIFT}}) + 3.93073.$

B = $0.0015 \times \text{LvgEvap} + 0.934.$

LIFT = LvgCond – LvgEvap.

LvgCond = full-load condenser leaving fluid temperature, °F.

LvgEvap = full-load evaporator leaving temperature, °F.

The FL_{adj} and PLV_{adj} values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

- 36.00°F ≤ LvgEvap ≤ 60.00°F.
- LvgCond ≤ 115.00°F.
- 20.00°F ≤ LIFT ≤ 80.00°F.

Centrifugal chillers designed to operate outside of these ranges are not covered by this code.

b. **For Water-Cooled Centrifugal Units Rated per AHRI Standard 551/591 (SI)**. Equipment not designed for operation at AHRI Standard 551/591 test conditions of 7.00°C leaving and 12.00°C entering chilled-fluid temperatures, and with 30.00°C entering and 35.00°C leaving condenser-fluid temperatures, shall have maximum full-load (FL) COP and part-load rating requirements adjusted using the following code:

$FL_{adj} = FL \times K_{adj}$

$PLV_{adj} = IPLV \times K_{adj}$

$K_{adj} = A \times B$

where:

FL = full-load COP value from ANSI/ASHRAE/IES Standard 90.1, Table 6.8.1-3.

FL_{adj} = minimum full-load COP rating, adjusted for nonstandard conditions.

IPLV = IPLV value from ANSI/ASHRAE/IES Standard 90.1, Table 6.8.1-3.

LvgEvap = full-load evaporator leaving temperature, °C.

The FL_{adj} and PLV_{adj} values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

- 2.20°C ≤ LvgEvap ≤ 15.60°C.
- LvgCond ≤ 46.00°C.
- 11.00°C ≤ LIFT ≤ 44.00°C.

Centrifugal chillers designed to operate outside of these ranges are not covered by this code.

701.4.3.2 (7.4.3.2) Ventilation Controls for Densely Occupied Spaces. The requirements in this section supersede those in IECC, Section C403.7.1. *Demand control ventilation* (*DCV*) shall be provided for *densely occupied spaces* served by systems with one or more of the following:

a. An air-side economizer.

b. *Automatic* modulating control of the *outdoor air* dampers.

c. A design outdoor airflow greater than 1000 cfm (500 L/s).

Exceptions:

1. Systems with exhaust air energy recovery complying with Section 701.4.3.7 (7.4.3.7).
2. Systems with a design outdoor airflow less than 750 cfm (375 L/s).
3. *Spaces* where more than 75% of the *space* design outdoor airflow is used as *makeup air* or *transfer air* to provide *makeup air* for other

PLV_{adj} = minimum *NPLV* rating, adjusted for nonstandard conditions.

A = $0.00000153181 \times (\text{LIFT})^4 - 0.000202076 \times (\text{LIFT})^3 + 0.0101800 \times (\text{LIFT})^2 - 0.264958 \times \text{LIFT} + 3.93073.$

B = $0.0027 \times \text{LvgEvap} + 0.982.$

LIFT = LvgCond – LvgEvap.

LvgCond = full-loaded condenser leaving fluid *spaces*.

4. *Spaces* with one of the following occupancy categories as listed in ANSI/ASHRAE Stan- dard 62.1: cells in correctional facilities; day- care sickrooms; science laboratories;

barbershops; beauty and nail salons; and bowling alleys (seating).

The *DCV* system shall be designed to be in compli- ance with ASHRAE Standard 62.1, Section 6.2.7.1. Occupancy assumptions shall be shown in the design documents for *spaces* provided with *DCV*. All CO_2 sen- sors used as part of a *DCV* system or any other system that dynamically controls *outdoor air* shall meet the following requirements:

a. *Spaces* with CO_2 sensors or air-sampling probes leading to a central CO_2 monitoring station shall be provided with at least one sensor or probe for each 10,000 ft^2 (1000 m^2) of floor *space*. Sensors or probes shall be installed between 3 and 6 ft (1 and 2 m) above the floor.

b. CO_2 sensors shall have a rated accuracy of ±50 ppm at 1000 ppm.

c. *Outdoor air* CO_2 concentrations shall be determined by one of the following:

1. *Outdoor air* CO_2 concentrations shall be dynamically measured using one or multiple CO_2 sensors. The CO_2 sensor locations shall be identified on the *construction documents*.

2. When documented statistical data on the local ambient CO_2 concentrations are available, a fixed value typical of the location where the building is located shall be allowed in lieu of an outdoor sensor.

d. Occupant CO_2 generation rate assumptions shall be shown in the design documents.

701.4.3.3 (7.4.3.3) Duct Leakage Tests. Leakage tests shall comply with the requirements in ANSI/ASHRAE/IES Standard 90.1, Section 6.4.4.2.2, with the following modification. Ductwork that is designed to operate at static pressures in excess of 2 in. of water (500 Pa), and all ductwork located outdoors, shall be leak-tested according to industry-accepted test procedures.

701.4.3.4 (7.4.3.4) Economizers. Systems shall include economizers meeting the requirements in the IECC, Section C403.5, except as modified by the following:

a. Rooftop units with a capacity of less than 54,000 Btu/h (16 kW) shall have two stages of capacity control, with the first stage controlling the economizer and the second stage controlling *mechanical cooling*. Units with a capacity equal to or greater than 54,000 Btu/h (16 kW) shall comply with the staging requirements defined in ANSI/ASHRAE/IES Standard 90.1, Section 6.5.3.1

b. For systems that control to a fixed leaving air temperature (i.e., *variable-air-volume* [*VAV*] systems), the system shall be capable of resetting the supply air temperature up at least 5°F (3°C) during economizer operation.

All of the exceptions in the IECC, Section C403.5, shall apply except as modified by the following.

a. IECC, Section C403.5, Exception 5, shall be permitted to eliminate the economizer requirement, provided the requirements in the IECC, Table C403.5(2), are applied to the efficiency requirements required by Section 701.4.1.1.2 (7.4.1.1.2).

b. For water-cooled units with a capacity less than 54,000 Btu/h (16 kW) that are used in systems where heating and cooling loads are transferred within the building (i.e., water-source heat pump systems), the requirement for an air or water economizer can be eliminated if the con- denser-water temperature controls are capable of being set to maintain full-load heat rejection capacity down to a 55°F (12°C) condenser-water supply temperature, and the HVAC equipment is capable of operating with a 55°F (12°C) condenser-water supply temperature.

701.4.3.5 (7.4.3.5) Reserved(7.4.3.6) Fan System Power and Efficiency.

(7.4.3.6.1) Fan System Power Limita- tion. Systems shall have fan power limitations 10% below the limitations specified in the IECC, Table C403.8.1(1). This requirement supersedes the require- ment in the IECC, Section C403.8, and the IECC, Table C403.8.1(2). All exceptions in the IECC, Section C403.8, shall apply.

701.4.3.6.1 (7.4.3.6.2) Fan Efficiency. The fan efficiency requirements defined in the IECC, Section C403.8.3, shall be used, except that the total efficiency of the fan at the design point of operation shall be within ten percentage points of the maximum total efficiency of the fan. All exceptions in the IECC, Section C403.8.3, shall apply.

701.4.3.6.2 (7.4.3.6.3) Low Capacity Fans. The fan efficiency requirements defined in the IECC, Section C403.8.5, shall be used, except that Table C403.8.5, shall be superseded by the requirements in Table 701.4.3.6.

TABLE 701.4.3.4 (TABLE 7.4.3.4)
MINIMUM SYSTEM SIZE FOR WHICH AN ECONOMIZER IS REQUIRED

CLIMATE ZONES	COOLING CAPACITY FOR WHICH AN ECONOMIZER IS REQUIRED[a]
5B	33,000 Btu/h (9.7 kW)[a]

a. Where economizers are required, the total capacity of all systems without economizers shall not exceed 480,000 Btu/h (140 kW) per building or 20% of the building's air economizer capacity, whichever is greater.

TABLE 701.4.3.6 (TABLE 7.4.3.6.3)
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	MINIMUM EFFICACY (CFM/WATT)
HRV or ERV	1.2 cfm/watt
In-line fan	3.8 cfm/watt
Bathroom, utility room	6.0 cfm/watt

701.4.3.7 **(7.4.3.7) Exhaust Air Energy Recovery.** The exhaust air energy recovery shall comply with the requirements defined in the IECC, Section C403.7.4, including the requirements in Tables C403.7.4(1) and C403.7.4(2). The energy recovery effectiveness shall not be less than 60%, and this shall supersede the requirement of the IECC.

701.4.3.8 **(7.4.3.8) Kitchen Exhaust Systems.** The requirements in the IECC, Section C403.7.5, shall apply, except as follows:

701.4.3.8.1 (7.4.3.8.1) For kitchen/dining facilities with total kitchen hood exhaust airflow rate greater than 2000 cfm (950 L/s), the maximum exhaust flow rate for each hood shall be determined in accordance with Table 701.4.3.8.1 (7.4.3.8.1). For single hoods, or hood sections installed over appliances with different duty ratings, the maximum allowable exhaust flow rate for the hood or hood section shall be determined in accordance with Table 701.4.3.8.1 (7.4.3.8.1) for the highest appliance duty rating under the hood or hood section. Refer to ANSI/ ASHRAE Standard 154 for definitions of hood type, appliance duty, and net exhaust flow rate.

Exception: When at least 75% of all the replacement air is *transfer air* that would otherwise be exhausted.

701.4.3.8.2 (7.4.3.8.2) Kitchen/dining facilities with total kitchen hood exhaust airflow rate greater than 2000 cfm (950 L/s) shall comply with at least one of the following:

a. At least 50% of all replacement air must be *transfer air* that would otherwise be exhausted.

b. At least 75% of kitchen hood exhaust air shall be controlled by demand ventilation system, which shall:

1. Be capable of reducing exhaust and replacement air system airflow rates by no more than the larger of:

i. 50% of total design exhaust and replacement air system airflow rate; or

ii. The outdoor airflow and exhaust rates required to meet the ventila- tion and exhaust requirements of Sections 6.2 and 6.5 of ASHRAE Standard 62.1 for the zone.

2. Include controls to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent, and combustion prod- ucts during cooking and idle;

3. Include controls that result in full flow when the demand ventilation systems fail to modulate airflow in response to appliance operation; and

4. Allow occupants to temporarily override the systems to full flow.

c. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40% shall be applied on at least 50% of the total exhaust airflow.

d. When *makeup air* is uncooled or cooled without the use of *mechanical cooling*, the capacity of any nonmechanical *cooling* systems (***Informative Note:*** e.g., natural cooling or evaporative cooling) shall be demon- strated to be no less than the system capacity of a *mechanical cooling* system necessary to meet the same loads under design conditions.

701.4.3.9 **(7.4.3.9) Duct Insulation.** Duct insulation shall comply with the minimum requirements in Nor- mative Appendix A, Tables A-2 and A-3. These requirements supersede the requirements in the IECC, Section C403.11.1.

701.4.3.10 **(7.4.3.10) Automatic Control of HVAC and Lights in Hotel/Motel Guest Rooms.** In hotels and motels with over 50 guest rooms, *automatic con- trols* for the lighting, switched outlets, television, and HVAC equipment serving each guest room shall be configured according to the following requirements.

TABLE 701.4.3.8.1 (TABLE 7.4.3.8.1)
MAXIMUM NET EXHAUST FLOW RATE PER LENGTH OF HOOD

TYPE OF HOOD	LIGHT-DUTY EQUIPMENT		MEDIUM-DUTY EQUIPMENT		HEAVY-DUTY EQUIPMENT		EXTRA-HEAVY-DUTY EQUIPMENT	
	cfm per linear foot	L/s per linear metre	cfm per linear foot	L/s per linear metre	cfm per linear foot	L/s per linear metre	cfm per linear foot	L/s per linear metre
Wall-mounted canopy	140	217	210	325	280	433	385	596
Single island [a]	280	433	350	541	420	650	490	758
Double island (per side)	175	271	210	325	280	433	385	596
Eyebrow	175	271	175	271	Not allowed	Not allowed	Not allowed	Not allowed
Backshelf/Passover	210	325	210	325	280	433	Not allowed	Not allowed

a. The total exhaust flow rate for all single-island hoods in a kitchen/dining facility shall be no more than 5000 cfm (2360 L/s).

701.4.3.10.1 (7.4.3.10.1) Lighting and Switched Outlet Control. Within 30 minutes of all occupants leaving the guest room, power for lighting and switched outlets shall be automatically turned off.

701.4.3.10.2 (7.4.3.10.2) Television Control. Within 30 minutes of all occupants leaving the guest room, televisions shall be automatically turned off or placed in sleep or standby mode.

701.4.3.10.3 (7.4.3.10.3) HVAC Set-Point Con-
trol. Within 30 minutes of all occupants leaving the guest room, HVAC set points shall be automatically raised by at least 5°F (3°C) from the occupant set point in the cooling mode and automatically lowered by at least 5°F (3°C) from the occupant set point in the heating mode. When the guest room is unrented and unoccupied, HVAC set points shall be automati- cally reset to 80°F (27°C) or higher in the cooling mode and to 60°F (16°C) or lower in the heating mode. Unrented and unoccupied guest rooms shall be determined by either of the following criteria:

a. The guest room has been continuously unoc- cupied for up to 16 hours.

b. A *networked guest-room control system* indi- cates the guest room is unrented and the guest room is unoccupied for no more than 30 min- utes.

Exceptions:

1. A *networked guest-room control system* may return the thermostat set points to their default set points 60 minutes prior to the time the room is scheduled to be occupied.

2. Cooling for humidity control shall be per- mitted during unoccupied periods.

701.4.3.10.4 (7.4.3.10.4) Ventilation Control. Within 30 minutes of all occupants leaving the guest room, ventilation and exhaust fans shall be automat- ically turned off, or *isolation devices* serving each guest room shall automatically shut off the supply of *outdoor air* to the room and shut off exhaust air from the guest room. In conjunction with the *automatic* ventilation shutoff, an *automatic* preoccu- pancy purge cycle shall provide *outdoor air* ventilation as specified in Section 801.3.1.6 (8.3.1.6).

701.4.3.10.5 (7.4.3.10.5) Automatic Control. Cap- tive keycard systems shall not be used to comply with Section 701.4.3.10 (7.4.3.10).

701.4.4 **(7.4.4) Service Water Heating.** The *service water heating* shall comply with the IECC, Section C404, with the following modifications and additions.

701.4.4.1 (7.4.4.1) Equipment Efficiency . All *building proj- ects* shall com- ply with the applicable equipment efficiency require- ments in Normative Appendix B, Table B101.9 (B-9),

and with the applicable ENERGY STAR requirements in Section 701.4.7.3.2 (7.4.7.3.2). These requirements supersede the requirements in the IECC, Table C404.2.

701.4.4.2 (7.4.4.2) Insulation for Spa Pools. Pools heated to more than 90°F (32°C) shall have side and bottom surfaces insulated on the exterior with a mini- mum insulation value of R-12 (R-2.1).

701.4.4.3 (7.4.4.3) High Output Service Water Heating Systems. These requirements shall supercede the requirements of IECC, Section C404.2.1. Where *buildings* have a total service water heating load of 1,000,000 Btu/h (293 kW) or greater, the water heating equipment shall have a minimum rated efficiency of 0.95 Et, 0.95 AFUE, 2.4 UEF or 2.0 COP. (**Alternate version**: These requirements shall supercede the requirements of IECC, Section C404..2.1. Where *buildings* have a total service water heating load of 1,000,000 Btu/h (293 kW) or greater provided by gas-fired equipment, the combined input-capacity-weighted-average thermal efficiency, Et, of all such equipment shall be not less than 95 percent.)

701.4.5 **(7.4.5) Reserved (7.4.6) Lighting.** The lighting shall comply with the IECC, Sections C405.2 through C405.4, with the following modifications and additions.

701.4.5.1 (7.4.6.1) Lighting Power Allowance

701.4.6.1.1 (7.4.6.1.1) Interior Lighting Power Densities (LPDs). The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 70 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

701.4.6.1.2 (7.4.6.1.2) Exterior LPDs. The exterior *lighting power allowance* shall be determined using the IECC, Section C405.4.1, with the following modification. The LPDs from the IECC, Table C405.4.2(2), shall be multiplied by the appropriate LPD factor from Table 701.4.6.1.2 (7.4.6.1.2).

701.4.6.1.3 (7.4.6.1.3) Horticulture Lighting. Not less than 95 percent of the permanently installed luminaires used for plant growth and maintenance shall have a photon efficiency of not less than 1.6 µmol/J rated in accordance with ANSI/ASABE S640.

701.4.5.2 (7.4.6.2) Occupancy Sensor Controls with Multilevel Switching or Dimming. The lighting in commercial and industrial storage stack areas shall be controlled by an occupant sensor with multilevel switching or dimming system that reduces lighting power a minimum of 50% within 20 minutes of all occupants leaving the stack area.

Exception: Storage stack areas illuminated by high-intensity discharge (HID) lighting with an LPD of 0.8 W/ft^2 (8.6 W/m^2) or less.

701.4.5.3 (7.4.6.3) Automatic Controls for Egress and Security Lighting. Lighting in any area within a building that is required to be continuously illuminated for reasons of building security or emergency egress shall not exceed 0.1 W/ft^2 (1 W/m^2). Additional egress and security lighting shall be allowed, provided it is controlled by an *automatic* control device that turns off the additional lighting.

701.4.5.4 (7.4.6.4) Controls for Exterior Sign Light- ing. All exterior sign lighting, including internally illumi- nated signs and lighting on externally illuminated signs, shall comply with the requirements of Sections 701.4.6.4.1 (7.4.6.4.1) or 701.4.6.4.2 (7.4.6.4.2).

Exceptions:

1. Sign lighting that is specifically required by a health or life safety statute, ordinance, or regu- lation.
2. Signs in tunnels.

TABLE 701.4.6.1.2 (TABLE 7.4.6.1.2) LIGHTING POWER ALLOWANCE FACTORS

	LIGHTING ZONE				
	LZ0	LZ1	LZ2	LZ3	LZ4
For tradable areas, uncovered parking areas: parking areas and drives with measured *SRI* < 29 or without *SRI* measurement	Not allowed	1	0.75	0.83	0.63
For tradable areas, uncovered parking areas: parking areas and drives with new concrete without added color pigment or with measured *SRI* ≥ 29	Not allowed	1	1	1	1
For tradable areas, other	1.00	0.90	0.90	0.95	0.95
For nontradable areas	1.00	0.95	0.95	0.95	0.95

controlled zone for a period no longer than 15

701.4.6.4.1 (7.4.6.4.1) All sign lighting that operates more than one hour per day during *daylight hours* shall include controls to automatically reduce the input power to a maximum of 35% of full power for a period from one hour after sunset to one hour before sunrise.

Exception: Sign lighting using neon lamps with controls to automatically reduce the input power to a maximum of 70% of full power for a period from one hour after sunset to one hour before sunrise.

701.4.6.4.2 (7.4.6.4.2) All other sign lighting shall include the following:

a. Controls to automatically reduce the input power to a maximum of 50% of full power for a period from midnight or within one hour of the end of business operations, whichever is later, until 6:00 am or business opening, whichever is earlier.

b. Controls to automatically turn off during *daylight hours.*

701.4.6.5 **(7.4.6.5) Parking and Outdoor Sales Lighting.** This section supersedes the IECC, Section C.405.4.2, for lighting serving uncovered parking areas and open areas in outdoor sales lots. Outdoor luminaires serving uncovered park- ing areas and open areas in outdoor sales lots shall be controlled by all of the following:

a. Luminaires shall be controlled by a device that automatically turns off the luminaire during *daylight hours*.

b. Luminaires shall be controlled by a timeclock or other control that automatically turns off the luminaire according to a timed schedule.

c. For luminaires having a rated input wattage of more than 50 W and where the bottom of the luminaire is mounted 24 ft (7.3 m) or less above the ground, the luminaires shall be controlled by one or more devices that automatically reduce lighting power of each luminaire by a minimum of 50% when there is no activity detected in the

minutes. No more than 1500 input watts of light- ing power shall be controlled together.

Exceptions:

1. Lighting serving street frontage for vehicle sales lots.
2. Lighting for covered vehicle entrances or exits from buildings or parking struc- tures where required for safety, security, or eye adaptation.

701.4.7 (7.4.7) Other Equipment. The other equipment shall comply with the IECC, Sections C405.5 through C405.9, with the following modifications and additions.

701.4.7.1 (7.4.7.1) Equipment Efficiency . All *building proj- ects* shall com- ply with the applicable equipment efficiency require- ments in Normative Appendix B and the applicable ENERGY STAR requirements in Section 701.4.7.3.2 (7.4.7.3.2).

701.4.7.2 (7.4.7.2) Supermarket Heat Recovery. Supermarkets with a floor area of 25,000 ft^2 (2500 m^2) or greater shall recover waste heat from the condenser heat rejection on *permanently installed* refrigeration equipment meeting one of the following criteria:

a. Twenty-five percent (25%) of the refrigeration system full-load total heat rejection.
b. Eighty percent (80%) of the *space* heat, *service water heating*, and dehumidification reheat.

If a recovery system is used that is installed in the refrigeration system, the system shall not increase the saturated condensing temperature at design conditions by more than 5°F (3°C) and shall not impair other head pressure control/energy reduction strategies.

701.4.7.3 (7.4.7.3) ENERGY STAR Equipment. All *building projects* shall comply with the requirements in Section 701.4.7.3.1 (7.4.7.3.1) and Section 701.4.7.3.2 (7.4.7.3.2).

701.4.7.3.1 (7.4.7.3.1) ENERGY STAR Requirements for Equipment not Covered by Federal Appliance Efficiency Regulations (All Building Projects). The following equipment within the scope of the applicable ENERGY STAR program shall comply with the equivalent criteria required to achieve the ENERGY STAR label if installed prior to the issuance of the certificate of occupancy:

a. Appliances:
    1. Room air cleaners: ENERGY STAR Program Requirements for Room Air Cleaners.
    2. Water coolers: ENERGY STAR Program Requirements for Water Coolers.

b. Heating and Cooling:
    1. Programmable thermostats: ENERGY STAR Program Requirements for Programmable Thermostats.
    2. Ventilating fans: ENERGY STAR Program Requirements for *Residential* Ventilating Fans.

c. Electronics:
    1. Cordless phones: ENERGY STAR Program Requirements for Telephony.
    2. Audio and video: ENERGY STAR Program Requirements for Audio and Video.
    3. Televisions: ENERGY STAR Program Requirements for Televisions.
    4. Set-top boxes: ENERGY STAR Program Requirements for Set-Top Boxes.

d. Office Equipment:
    1. Computers: ENERGY STAR Program Requirements for Computers.
    2. Copiers: ENERGY STAR Program Requirements for Imaging Equipment.
    3. Fax machines: ENERGY STAR Program Requirements for Imaging Equipment.
    4. Laptops: ENERGY STAR Program Requirements for Computers.
    5. Mailing machines: ENERGY STAR Program Requirements for Imaging Equipment.
    6. Monitors: ENERGY STAR Program Requirements for Displays.
    7. Multifunction devices (printer/fax/scanner): Program Requirements for Imaging Equipment.
    8. Printers: ENERGY STAR Program Requirements for Imaging Equipment.

9. Scanners: ENERGY STAR Program Requirements for Imaging Equipment.
10. Computer servers: ENERGY Star Pro- gram Requirements for Computer Servers.

e. Lighting:

1. Integral LED lamps: ENERGY STAR Program Requirements for Integral LED Lamps.

f. Commercial Food Service:

1. Commercial fryers: ENERGY STAR Program Requirements for Commer- cial Fryers.
2. Commercial hot food holding cabinets: ENERGY STAR Program Require- ments for Hot Food Holding Cabinets.
3. Commercial steam cookers: ENERGY STAR Program Requirements for Commercial Steam Cookers [see also water efficiency requirements in Section 601.3.2.5 (6.3.2.5)].
4. Commercial dishwashers: ENERGY STAR Program Requirements for Commercial Dishwashers.
5. Commercial griddles: ENERGY STAR Program Requirements for Commercial Griddles.
6. Commercial ovens: ENERGY STAR Program Requirements for Commer- cial Ovens [see also water efficiency requirements in Section 601.3.2.5 (6.3.2.5)].

701.4.7.3.2 (7.4.7.3.2) ENERGY STAR Requirements for Equipment Covered by Federal Appli- ance Efficiency Regulations . All *building projects* shall comply with the equivalent criteria required to achieve the ENERGY STAR label if installed prior to the issuance of the certificate of occupancy. For those products listed below that are also contained in Normative Appen- dix B, the installed equipment shall comply by meeting or exceeding both the requirements in this section and in Normative Appendix B.

a. Appliances:

1. Clothes washers: ENERGY STAR Pro- gram Requirements for Clothes Washers

[see also the water efficiency requirements in Section 601.3.2.2 (6.3.2.2)].

2. Dehumidifiers: ENERGY STAR Program Requirements for Dehumidifiers.
3. Dishwashers: ENERGY STAR Program Requirements Product Specifications for *Residential Dishwashers* [see also the water efficiency requirements in Section 601.3.2.2 (6.3.2.2)].
4. Refrigerators and freezers: ENERGY STAR Program Requirements for Refrigerators and Freezers.
5. Room air conditioners: ENERGY STAR Program Requirements and Criteria for Room Air Conditioners.

b. Heating and Cooling:

1. *Residential* air-source heat pumps: ENERGY STAR Program Requirements for ASHPs and Central Air Conditioners [see also the energy efficiency requirements in Section 701.4.1 (7.4.1)].
2. *Residential* boilers: ENERGY STAR Program Requirements for Boilers [see also the energy efficiency requirements in Section 701.4.1 (7.4.1)].
3. *Residential* central air conditioners: ENERGY STAR Program Requirements for ASHPs and Central Air Conditioners [see also the energy efficiency requirements in Section 701.4.1 (7.4.1)].
4. *Residential* ceiling fans: ENERGY STAR Program Requirements for *Residential* Ceiling Fans.
5. Dehumidifiers: ENERGY STAR Program Requirements for Dehumidifiers.
6. *Residential* warm air furnaces: ENERGY STAR Program Requirements for Furnaces.
7. *Residential* geothermal heat pumps: ENERGY STAR Program Requirements for Geothermal Heat Pumps.

a. Water Heaters: ENERGY STAR Program Requirements for Commercial Refrigerators and Freezers.

2. Commercial ice machines: ENERGY STAR Program Requirements for Com- mercial Ice Machines.

f. Other Products:

1. Battery charging systems: ENERGY STAR Program Requirements for Prod- ucts with Battery Charger Systems (BCSs).
2. External power adapters: ENERGY STAR Program Requirements for Sin- gle-Voltage AC-DC and AC-AC Power Supplies.
3. Vending machines: ENERGY STAR Program Requirements for Refrigerated Beverage Vending Machines.

701.4.7.4 **(7.4.7.4) Programmable Thermostats.** *Resi- dential* programmable thermostats shall meet the requirements of NEMA Standards Publication DC 3, Annex A, "Energy-Efficiency Requirements for Programmable Thermostats."

701.4.7.5 **(7.4.7.5) Refrigerated Display Cases.** All open refrigerated display cases shall be covered by using field-installed strips, curtains, or doors.

701.4.7.6 **(7.4.7.6) Electric Vehicle Charging**. The requirements of IECC, Section C405.10, shall be superceded by Section 501.3.7.3.

701.4.8 **(7.4.8) Energy Cost Budget.** The Energy Cost Budget option in ANSI/ASHRAE/IES Standard 90.1, Sec- tion 11, shall not be used.

701.5(7.5) Performance Option. . IECC, Section C401.2, option 3 shall not be used. *Buildings* shall comply with IECC, Section C401.2, option 1(c) with the following modifications.

701.5.1 (7.5.1) Annual Energy Cost. The Energy Cost Budget option IECC, Section C401.2, option 1(c)(1) shall not be used

701.5.2 (7.5.2) Annual Source Energy. For *buildings* that comply with IECC, IECC, Section C401.2, option 1(c)(2), the Source Energy Index Target (SEIt) shall be calculated in accordance with the following:

$$SEIt = 0.77 \times [BBUSE + (BPF \times BBRSE)] / BBP$$

Requirements for *Residential* Water Heaters.

b. Lighting:

1. Lamps: ENERGY STAR Program Requirements for Lamps (Light Bulbs).
2. Luminaires: ENERGY STAR Program Requirements for Luminaires.
3. *Residential* light fixtures: ENERGY STAR Program Requirements for *Residential* Light Fixtures.

c. Commercial Food Service:

1. Commercial refrigerators and freezers: ENERGY STAR Program Require-

701.6 (7.6) Zero Net Energy Option. Achieve and document Zero Net Energy performance where, on an annual basis, the energy consumed on site by the *building project* is less than the energy produced by an *on-site renewable energy system* in accordance with this section. Only all-electric buildings are eligible for this option

701.6.1 (7.6.1) Design. Prior to issuance of the *building permit,* submit documentation acceptable to the *building official* that the design is capable of achieving zero net energy performance as defined by this option.

701.6.2 (7.6.2) Documentation. Within 24 months of the issuance of the *certificate of occupancy, provide* documentation acceptable to the *code official* documenting a continuous 12-month period where the energy consumed on site by the *building project* is less than the energy produced by an *on-site renewable energy system.*

701.6.2.1 Occupancy. Documentation shall include the percentage of occupancy. Where the building has less than 100% occupancy during the compliance period, onsite renewable energy consumption shall be prorated by actual occupancy during the compliance period for the purposes of determining occupancy.

701.7 (7.7) Passive House Option. *Buildings* shall achieve Passive House certification in accordance with 701.6.1 or 701.6.2

701.7.1 (7.6.1) Passive House Institute US (PHIUS) Certification. Achieve certification with the PHIUS+ 2018 Passive Building Standard and provide documentation in accordance with Section 701.6.2.1.

701.7.1.1 (7.6.1.1) Documentation. Provide documentation to the code official demonstrating the following.

1. Prior to the issuance of a building permit, documentation of a PHIUS+ 2018 Certification Contract from PHIUS and a list of compliance features.
2. Prior to the issuance of a certificate of occupancy, copy of the final report submitted on a form that is approved by PHIUS to document compliance with the PHIUS+ 2018 Standard

701.7.2 (7.7.2) Passive House Institute (PHI) Certification. Achieve certification with the PHI Passive House Standard provide documentation in accordance

with 701.6.2.1.

701.7.2.1 (7.7.2.1) Documentation. Provide documentation to the code official demonstrating the following.

1. Prior to the issuance of a building permit, signed documentation from a PHI accredited Passive House Certifier of intent to certify building and a list of compliance features.
2. Prior to the issuance of a certificate of occupancy, a copy of the final report submitted on a form that is approved by PHI to document compliance with the Passive House Standard

CHAPTER 8

INDOOR ENVIRONMENTAL QUALITY (IEQ)

801.1 **(8.1) Scope.** This section specifies requirements for indoor environmental quality, including indoor air quality, environmental tobacco smoke control, *outdoor air* delivery monitoring, thermal comfort, *building entrances*, acoustic control, *lighting quality*, daylighting, and low-emitting materials.

801.2 (8.2) Compliance. The indoor environmental quality shall comply with Section 801.3 (8.3), "Mandatory Provisions" in accordance with Section 101.4.1, and either

a. Section 801.4 (8.4), "Prescriptive Option," or

b. Section 801.5 (8.5), "Performance Option."

Daylighting and low-emitting materials are not required to use the same option, i.e., prescriptive or performance, for demonstrating compliance.

801.3 (8.3) Mandatory Provisions

801.3.1 (8.3.1) Indoor Air Quality. Buildings shall comply with the design requirements of ANSI/ASHRAE Standard 62.1, Sections 4 through 6, including applicable normative appendices, with the modifications and additions indicated herein. Health care facilities shall comply with the design requirements of ANSI/ASHRAE/ASHE Standard 170, including applicable normative appendices, with the modifications and additions indicated herein. *Residential dwelling units* shall comply with the design requirements of ANSI/ASHRAE Standard 62.2, Sections 4 through 8, with the modifications and additions indicated herein.

Requirements provided in Sections 801.3.1.1 (8.3.1.1) through 801.3.1.7 (8.3.1.7) supersede such requirements in the International Mechanical Code.

801.3.1.1 (8.3.1.1) Minimum Ventilation Rates. In health care facilities, the ventilation requirements of ASHRAE/ASHE Standard 170 shall apply. In *residential dwelling units*, the *dwelling unit* ventilation rates and local exhaust airflow rates as required by ASHRAE Standard 62.2 shall apply. ASHRAE Standard 62.2, Section 4.1.2, shall not apply. In all other cases, the International Mechanical Code shall be used to determine minimum zone and intake outdoor airflow rates.

801.3.1.2 (8.3.1.2) Outdoor Air Delivery Monitoring.

801.3.1.2.1 (8.3.1.2.1) System Design for Outdoor Air Intake Measurement. Each mechanical ventilation system shall be configured to allow for the measurement of the *outdoor air* intake for use in testing and balancing, recommissioning, and *outdoor air* monitoring as required in Section 801.3.1.2.2 (8.3.1.2.2).

801.3.1.2.2 (8.3.1.2.2) Monitoring Requirements. Each mechanical ventilation system shall have a *permanently installed* device to measure the *minimum outdoor airflow* that meets the following requirements:

a. The device shall employ methods described in ANSI/ASHRAE Standard 111.

b. The device shall have an accuracy of ±10% of the *minimum outdoor airflow*. Where the *minimum outdoor airflow* varies, as in *demand control ventilation* (*DCV*) systems, the device shall maintain this accuracy over the entire range of occupancy and system operation.

c. The device shall be capable of notifying the building operator, either by activating a local indicator or sending a signal to a building monitoring system, whenever an *outdoor air fault condition* exists. This notification shall require manual reset.

Exception: Constant-volume air supply systems that do not employ *DCV* and that use an indicator to confirm that the intake damper is open to the position needed to maintain the design *minimum outdoor airflow* as determined during system startup and balancing.

801.3.1.3 (8.3.1.3) Filtration and Air Cleaner Requirements.

a. **Particulate Matter.** The following requirements shall apply in all buildings.

Exceptions: In health care facilities, the particulate filter requirements of ASHRAE/ ASHE Standard 170 shall apply.

1. **Wetted Surfaces.** Particulate matter filters or air cleaners having a minimum efficiency reporting value (MERV) of not less than 8 when rated in accordance with ANSI/ASHRAE Standard 52.2 shall be provided upstream of all cooling coils or other devices with wetted surfaces through which air is supplied to an *occupiable space*. These requirements supersede the requirements in ASHRAE

Standard 62.1, Section 5.8.

2. **Particulate Matter Smaller than 10 Micrometers (PM10).** Particulate matter filters or air cleaners shall be provided in

accordance with Standard 62.1, Section 6.2.1.1, with the following modification. Such filters or air cleaners shall have a MERV of not less than 8 when rated in accordance with ASHRAE Standard 52.2.

3. **Particulate Matter Smaller than 2.5 Micrometers (PM2.5).** Particulate matter filters or air cleaners shall be provided in accordance with Standard 62.1, Section 6.2.1.2, with the following modification. Such filters or air cleaners shall have a MERV of not less than 13 when rated in accordance with ASHRAE Standard 52.2.

b. **Ozone.** Air cleaning devices for ozone shall be provided for buildings located in an area that is designated "non-attainment" in an area that exceeds the National Ambient Air Quality Standards (NAAQS) for ozone, as determined by the *authority having jurisdiction* (*AHJ*). Such air cleaning devices shall have an ozone removal efficiency of no less than 40% where installed, operated, and maintained in accordance with the manufacturer's recommendations. Such air cleaning devices shall be operated whenever the outdoor ozone level is expected to exceed the NAAQS. This requirement supersedes the requirements of ASHRAE Standard 62.1,Section 6.2.1.3. This requirement applies to all buildings, including health care facilities covered by ASHRAE/ASHE Standard 170.

c. **Sealing.** Where particulate matter filters or air cleaners are required by Section 801.3.1.3 (8.3.1.3), filter tracks, filter supports, filters, and access doors shall be sealed in accordance with the following:

1. Where filter track and filter support systems incorporate multiple filters, the gap between each filter shall be sealed with a gasket, and the gap between the filter and its track or support shall be sealed using gaskets that expand when the filter is removed. Filter support systems shall include a filter-to-support gasket *permanently installed* on the filter support, except for filter track and filter support systems that seal around the filter by means of a friction fit.

2. Filter tracks and filter supports shall be sealed to the HVAC equipment housing and ducts by a sealant or other sealing method.

3. Filter access doors shall be sealed to minimize filter bypass and air leakage into or out of the system.

4. Gaskets and seals used to comply with the requirements of this section shall be capable of effecting a seal for the anticipated life of the equipment, and the system shall

be designed such that the seals are readily accessible.

5. Field- or shop-fabricated *spacers* shall not be installed for the purpose of replacing the intended-size filter with a smaller-size fil- ter.

801.3.1.4 (8.3.1.4) Building Pressure. The require- ments in Section 801.3.1.4 (8.3.1.4) supersede the requirements in ASHRAE Standard 62.1, Section 5.9.2. *Building projects* shall be designed in accordance with the following subsections.

801.3.1.4.1 (8.3.1.4.1) Mechanical Exhaust. Mechanical systems shall include controls capable of disabling exhaust fans and closing exhaust damp- ers whenever mechanical intake airflow is discontin- ued.

Exception: Buildings requiring smoke control in accordance with IFC Section 909 as amended by the City of Denver.

801.3.1.5 (8.3.1.5) Reserved**(8.3.1.6) Humidity Control.** The require- ments in this section supersede the requirements in ASHRAE Standard 62.1, Section 5.9.1. Mechanical air- conditioning and evaporative cooling systems shall be

designed in accordance with Sections 801.3.1.4.1 (8.3.1.4.1) and 801.3.1.4.2 (8.3.1.4.2), as applicable.

Exceptions:

1. Systems serving *HVAC zones* with construction, furnishings, and fixtures that manage liquid water and high humidity using impervious or moisture-retardant surfaces and other means.
2. Systems where performance simulation demonstrates that *HVAC zone* relative humidity levels during cooling do not exceed 65% rh for more than 48 consecutive hours.

801.3.1.6.1 (8.3.1.6.1) Reserved**(8.3.1.6.2) Direct Evaporative Cool- ing.** Direct evaporative cooling systems shall include devices and controls capable of limiting *HVAC zone* relative humidity to not exceed 65% rh for more than 48 consecutive hours.

(8.3.1.7) Reserved **(8.3.1.8) Building Entrances.** All *building entrances* shall employ a permanent entryway system at least 10 feet long in the primary direction of travel at regularly used exterior entrances. The entryway system shall be a permanently installed grate, grille, slotted system that allows for cleaning underneath, rollout mat, or any other material manufactured as an entryway system with equivalent or better performance.

801.3.2 **(8.3.2) Thermal Environmental Conditions for Human Occupancy.** The building shall be designed in compliance with ANSI/ASHRAE Standard 55, Sections 6.1, "Design," and 6.2, "Documentation."

Exception: *Spaces* with special requirements for processes, activities, or contents that require a thermal environment outside that which humans find thermally acceptable, such as food storage, natatoriums, shower rooms, saunas, and drying rooms.

801.3.3.1 **(8.3.3) Acoustical Control.** The provisions of this section shall govern acoustical control for the *building envelope*, the interior *spaces* within the building or structure, and the design of the related mechanical equipment and systems. School *spaces* identified in ANSI/ASA S12.60 shall comply with ANSI/ASA S12.60. Healthcare *spaces*, as defined in the FGI Guidelines, shall comply with the FGI Guidelines.**(8.3.3.1) Documentation.** *Construction documents* and supplemental information necessary to ver- ify compliance with this code, such as calculations, worksheets, laboratory test reports, field test reports, compliance forms, *vendor* literature, or other data, shall be reviewed by a person experienced in the field of acoustics and who shall report compliance or noncom- pliance with the required acoustical performance. The *construction documents* and any reports shall show all the pertinent data and features of the building, equip- ment, and systems in sufficient detail to permit a deter- mination of compliance by the *authority having jurisdiction* (*AHJ*) and to indicate compliance with the requirements of this code.

801.3.3 **(8.3.4) Soil-Gas Control.** Soil-gas entry into *enclosed spaces* that are immediately above crawlspaces, slabs-on-grade, and basement slabs shall be controlled in accordance with the *International Building Code* and Sections 801.3.4.1 (8.3.4.1) or 801.3.4.2 (8.3.4.2).

Exceptions:

1. Buildings or portions thereof that are not rou- tinely occupied, such as warehouses and parking structures.
2. Ventilated garages that comply with ANSI/ ASHRAE Standard 62.1, Sections 5.15 and 6.5.

801.3.4.1 (8.3.4.1) Soil-Gas Control Systems.

801.3.4.1.1 (8.3.4.1.1) Soil-Gas Barriers. Soil-gas retarder systems shall be provided and shall comply with all of the following:

a. Earthen floors in basements and enclosed crawlspaces shall be covered with a soil-gas retarder membrane. Such membrane shall be sealed to the foundation at the edges. Soil-gas retarder membranes or systems shall be placed between slab floors and the base course gas- permeable layer required by Section 801.3.4.1.2 (8.3.4.1.2). Soil-gas retarder mate- rials shall meet or exceed the durability requirements of ASTM E1745, and the instal- lation shall comply with ASTM E1643.

   Damp-proofing or waterproofing materials shall be installed on the exterior surface of foundation *walls* and shall extend from the top of the footing to above grade.

b. Joints in concrete around the perimeter of each poured slab section shall be permanently sealed with closed-cell gasket materials or equivalent methods that retain closure after the slab has cured.

c. Openings in slab floors; below-grade masonry *walls*; and membranes, such as those for plumbing, ground water control systems, soil vent pipes, electrical, mechanical piping, and structural supports, shall be sealed at the penetration with caulk that complies with ASTM C920 class 25 or higher equivalent closed-cell gasket materials or other equivalent method.

d. Sumps shall be covered with a rigid lid that is mechanically fastened and sealed with a gasket or caulk that will allow removal of the lid for maintenance.

e. Hollow masonry unit *walls* shall be designed and constructed as follows:

1. The first course of masonry units bear- ing on a footing shall be laid with a full mortar bedding and shall be solid units or fully grouted masonry units.

2. Where portions of masonry units are below grade and in contact with earth, the course of masonry units that is at or partially below grade shall be made of solid masonry units or fully grouted masonry units. Such course of masonry units need not change elevation to com- pensate for lower-grade elevations along the building perimeter. Openings in *walls* that are below such course of solid or fully grouted masonry units, such as window and door openings, shall be sur- rounded by solid or fully grouted masonry units.

801.3.4.1.2 (8.3.4.1.2) Gas-Permeable Layer and Soil-Gas Conveyance. There shall be a continuous gas-permeable layer under each slab-on-grade and basement slab for the entire area of the slab and under each membrane installed over earth for the entire area of the membrane. Perforated pipe, geo- textile matting, or soil-gas collection pits shall be installed below the slab or membrane and shall be connected to exhaust vent pipe as specified in Sec- tion 801.3.4.1.3 (8.3.4.1.3). The gas-permeable layer and soil-gas conveyance pipe shall comply with Table 801.3.4.1.2 (8.3.4.1.2) and (a), (b), or (c) as applicable.

a. **Stone Aggregate Layer.** The gas-permeable layer shall be a uniform layer not less than 4 in. (0.1 m) in depth and shall consist of gravel or crushed stone that meets ASTM C33 requirements for size numbers 5, 56, 57, or 6. Vent pipe openings to unobstructed interstices between stones within the gas-permeable layer shall not be less than the equivalent values indicated in Table 801.3.4.1.2 (8.3.4.1.2).

b. **Small Stone, Sand, and Soil.** The gas-perme- able layer shall be a uniform layer not less than 4 in. (0.10 m) in depth that consists of any of the following:

1. Small stone aggregates classified in ASTM C33 as size numbers 467,67,7, or 8.

2. Sand classified in ASTM C33 as size number 9.

3. Soil that contains less than 35% sand, rock fragment fines, clay, and silt. Such clay and silt shall consist of not more than 10% high-plasticity clay or silt.

Perforated pipe or geotextile drainage matting shall be placed at distances not farther than 20 ft (6 m) apart and not farther than 10 ft (3 m) away from foundation *walls* or other surfaces that surround the gas-permeable layer. Perforated pipe shall be surrounded by not less than 4 in. (0.10 m) of gas-permeable aggregates that meet ASTM C33 requirements for size numbers 5, 56, 57, or 6. The minimum length and soil-gas inlet openings in the perfo- rated pipe and geotextile matting shall not be less than equivalent values indicated in Table 801.3.4.1.2 (8.3.4.1.2).

c. **Crawlspace Membranes.** Perforated pipe or equivalent material not less than 10 ft (3 m) in length and 3 in. (0.08 m) in nominal diameter shall be provided under the membrane. The configuration shall allow air movement under the entire area of the membrane.

801.3.4.1.2.1 (8.3.4.1.2.1) Soil-Gas Convey-ance Clearance and Dimension. Geotextile mats and perforated pipe shall not be less than 12 in. (0.3 m) and not farther than 10 ft (3 m) from

TABLE 801.3.4.1.2 (TABLE 8.3.4.1.2) SOIL-GAS CONVEYANCE COMPONENTS

SYSTEM VENT PIPE NOMINAL DIAMETER	MINIMUM DIAMETER OF PITS [a]	MINIMUM LENGTH OF PERFORATED PIPE OR GEOTEXTILE MATTING [b]
3 in. (0.08 m)	12 in. (0.30 m) diameter pit	18 ft (5.4 m)
4 in. (0.10 m)	16 in. (0.40) diameter pit	32 ft (10 m)
6 in. (0.15 m)	24 in. (0.60 m) diameter pit	71 ft (22 m)

a. Pits shall not be less than 4 in. (0.10 m) in depth.
b. Openings in perforated pipe and geotextile matting shall not be less than 1.0 $in.^2$/ft (21 cm^2/m) of pipe or matting length.

foundation *walls* or other surfaces that surround the gas-permeable layer. Soil-gas inlet openings into the geotextile mats and perforated pipe shall

have an area of not less than 1.0 $in.^2$/ft (21 cm^2/m) of length. The airway path within geotextile mats and perforated pipe shall not be less than the nominal equivalent area of 3 in. (0.08 cm) pipe inner diameter. Pipe materials below slabs and membranes shall be configured to drain collected water within piping.

801.3.4.1.2.2 (8.3.4.1.2.2) Connections to Exhaust Vent Pipes. Exhaust vent piping, as specified in Section 801.3.4.1.3 (8.3.4.1.3), shall connect to soil-gas inlet configurations within the gas-permeable layer and extend not less than 2 ft (0.6 m) above the top of the slab or membrane. Such pipes shall be temporarily capped or other- wise closed during construction to prevent debris from entering the pipes. The pipe that extends above the slab or membrane shall be labeled with the words "radon vent" or "soil-gas vent" in the prevailing language at the location.

801.3.4.1.3 (8.3.4.1.3) Soil-Gas Exhaust Vent Pipe. Soil-gas exhaust vent piping shall be provided as follows:

a. **Pipe Placement.** Nonperforated Schedule 40 pipe, as defined by ASTM D1785, shall extend from within the gas-permeable layers to the point of exhaust above the *roof*. The vent pipe size shall not be reduced at any point between its connection to the gas permeable layers and the exhaust terminal above the *roof*. Such piping shall be labeled on each floor level of the building with the words "radon vent" or "soil-gas vent" in the prevailing language at the location.

b. **Multiple Vented Areas.** Where interior foot- ings divide a gas-permeable layer into two or more unconnected areas, such areas shall be interconnected by piping below the slab or membrane or above the slab or membrane. Such piping shall be nonperforated and of a size indicated in Table 801.3.4.1.3 (8.3.4.1.3).

c. **Provision for Fan.** Soil-gas venting systems shall include a fan or a dedicated *space* for the future installation of a fan. The fan and soil-gas vent piping on the discharge side of the fan shall not be installed within or underoccupied *spaces*. A dedicated *space* having a verti- cal height of not less than 48 in. (1.2 m) and a diameter of not less than 21 in. (0.53 m) shall be provided in the *attic* or other interior area to accommodate the installation of a fan. The fan inlet and outlet vent pipes shall be centered in such dedicated *space*. An electrical supply for the fan shall be provided within 6 ft (1.8 m) of the fan location.

d. **Vented Area.** The maximum foundation area served by a soil-gas exhaust vent pipe shall be determined in accordance with Table 801.3.4.1.3 (8.3.4.1.3).

Exception: Where inspections verify com- pliance with Sections 801.3.4.1.1 (8.3.4.1.1) through 801.3.4.1.3 (8.3.4.1.3), the maximum vented area per vent pipe indicated in Table 801.3.4.1 (8.3.4.1) shall be increased by 40%. Where the soil-gas barrier consists of a spray-applied vapor barrier or a geomembrane that provides a homogeneous closure, the maximum vented area per vent pipe shall be increased by an additional 20%.

TABLE 801.3.4.1.3 (TABLE 8.3.4.1.3) VENT PIPE DIAMETER PER VENTED AREA

VENT PIPE DIAMETER	MAXIMUM VENTED AREA PER VENT PIPE
3 in. (0.08 m)	2500 ft^2 (230 m^2)
4 in. (0.10 m)	4500 ft^2 (420 m^2)
6 in. (0.15 m)	10,000 ft^2 (1000 m^2)

801.3.4.2 (8.3.4.2) Alternative Methods of Soil-Gas Control. A soil-gas control system shall be provided, and such system shall be clearly identified or otherwise noted on *construction documents* and shall be approved by a qualified soil-gas professional and the *building project FPT provider*.

801.3.5 **(8.3.5) Lighting Quality.** The interior lighting

and lighting controls shall be installed to meet the requirements of Sections 801.3.5.1 (8.3.5.1) and 801.3.5.2 (8.3.5.2). Lamps for other than decorative lighting shall have a CRI no less than 80 and a minimum rated life of 24,000.

801.3.5.1 (8.3.5.1) Enclosed Office Spaces. Lighting for at least 90% of enclosed office *spaces* with less than 250 ft^2 (23.3 m^2) of floor area shall comply with at least one of the following:

a. Provide *multilevel lighting control*.

b. Provide *bilevel lighting control* and separate *task lighting*.

801.3.5.2 (8.3.5.2) Multioccupant Spaces. Lighting for conference rooms, meeting rooms, multipurpose rooms, gymnasiums, auditoriums, ballrooms, cafeterias, *classrooms*, and other training or lecture rooms shall be provided with *multilevel lighting control*. Lighting settings or the lighting controlled by each manual control shall be labeled at the control devices. The lighting in gymnasiums, auditoriums, ballrooms, and cafeterias shall also consist of at least two separately controlled groups of luminaires.

801.3.6 **(8.3.6) Moisture Control.** Either a dynamic heat and moisture analysis, in accordance with ANSI/ ASHRAE Standard 160, or steady-state water vapor trans- mission analysis, in accordance with Sections 801.3.6.1 (8.3.6.1) and 801.3.6.2 (8.3.6.2), shall be performed on above-grade portions of the *building envelope* and on inte- rior partitions as described in Section 801.3.6.2 (8.3.6.2). Conditions conducive to condensate formation, as demon- strated by analysis, shall not occur at any location within the *building envelope* or partition components or on the interior side of surfaces not specifically designed and con- structed to manage moisture.

Exception: Where analysis indicates that incidental condensate occurs in components engineered to allow or manage such condensate without damage to the *building envelope* components.

801.3.6.1 (8.3.6.1) Exterior Building Envelope. The analysis shall be conducted using the average of at least ten consecutive years of weather data for the *outdoor air* temperature for the warmest three months of the year (summer condition) and the *outdoor air* tempera- ture for the coldest three months of the year (winter condition). The analysis shall include all *building enve- lope* components, including interior *wall* finishes of the exterior *walls*.

801.3.6.2 (8.3.6.2) Humid Spaces. A separate analysis shall be performed in *spaces* where process or occu- pancy requirements dictate dew-point conditions that are unique with respect to other *spaces* in the building, such as kitchens, water therapy rooms, swimming-pool enclosures, ice rink enclosures, shower rooms, locker rooms, operating rooms in health care facilities, spaces for indoor horticulture and exhibit areas in museums.

801.3.6.2.1 (8.3.6.2.1) For exterior *building enve- lope* components of humid *spaces*, the analysis shall use the *outdoor air* temperature conditions described in Section 801.3.6.1 (8.3.6.1).

801.3.6.2.2 (8.3.6.2.2) For *walls*, floors, and ceilings between occupied *spaces* and adjacent *spaces*, the analysis shall be performed using design summer (cooling) conditions and design winter (heating) conditions of both types of *conditioned space*.

Exception: *Spaces* and their individual mechani- cal systems that are designed to

control conden- sation and moisture accumulation in the adjacent *building envelope*, *walls*, or ceilings.

801.3.6.3 **(8.3.6.3) Flashing of Fenestration, Door Assemblies, Mechanical Equipment, and Other Pen- etrations of Building Envelope.** Flashing or sealants shall be installed in accordance with the *International Building Code* around *fenestration*, door assemblies,

and penetrations associated with mechanical equipment and utility services, except where there is a mechanism for drainage to the outdoors or where the materials are designed for long-term contact with water.

801.3.7 **(8.3.7) Glare Control.** *View fenestration* for the *spaces* listed in Table 801.4.1.2A (8.4.1.2A) shall comply with this section.

View fenestration shall have one or more operable glare control devices capable of reducing the *specular visible transmittance* of the *fenestration* assembly to 3% or less. Such glare control devices shall allow an occupant or control system to change the device's position or light transmission level in order to address glare in the *space*. Operable glare control devices include movable interior window blinds, curtains, and shades; movable exterior louvers, screens, awnings, shades, and blinds; and *dynamic glazing*. Where fabric shades are used, the openness factor, also known as "direct-direct transmittance," shall be tested according to Standard EN14500.

Exceptions:

1. For buildings located greater than 20 degrees latitude north or south of the equator, *view fenestration* oriented within 10 degrees of true north in northern hemisphere locations or within 10 degrees of true south in southern hemisphere location.
2. Where permanent interior or exterior obstructions, such as buildings, structures, overhangs, and fins, have a *specular visible transmittance* of not greater than 3% and block a direct beam of sunlight from passing through the *view fenestration* at a point in the middle of the *view fenestration* both horizontally and vertically, at the peak solar altitude and four hours before and after the peak solar altitude on the summer solstice and the spring equinox as determined by sun-angle studies.
3. *Spaces* that have an *annual sunlight exposure* of not more than 93 fc (1000 lux) of direct sunlight illumination for more than 250 hours per year for less than 3% of the floor area.

801.3.8 **(8.3.8) Occupant Override.** Occupants shall have the capability to temporarily override *automatic* methods of glare control for periods not exceeding two hours.

801.4 (8.4) Prescriptive Option.

801.4.1 (8.4.1) Daylighting.

801.4.1.1 (8.4.1.1) Daylighting in Large Spaces Directly under a Roof and Having High Ceilings. *Enclosed spaces*, including conditioned and unconditioned *spaces*, meeting all of the following criteria, shall comply with Sections 801.4.1.1.1, 801.4.1.1.2 and 801.4.1.1.3 (8.4.1.1.1, 8.4.1.1.2 and 8.4.1.1.3):

a. The *space* is in a building with three stories or fewer above grade.
b. The *space* area is greater than 2500 ft^2 (232 m^2).

c. The *space* is located directly under a *roof*, and average ceiling heights are greater than 15 ft (4.6 m).

Exceptions:

1. *Spaces* in buildings located in *Climate Zones* 7 or 8.
2. Auditoria, motion picture theaters, performing arts theaters, museums, places of worship, and refrigerated warehouses.
3. *Enclosed spaces* where documentation shows that existing structures or natural objects block direct sunlight on at least 50% of the *roof* over the *enclosed space* at all three of the following times on the date of the spring equinox: three hours before solar noon (peak solar altitude), at solar noon, and three hours after solar noon.

801.4.1.1.1 (8.4.1.1.1) Minimum Daylight Area. Not less than 50% of the floor area shall be in the *daylight area* as defined in Chapter 3 (Section 3). For the purposes of Section 801.4.1.1.1 (8.4.1.1.1), the definition of *daylight area* shall be modified such that partitions and other obstructions that are less than the ceiling height are disregarded. *Daylight areas* shall be under *skylights*, under *roof monitors*, under tubular daylight devices. or in the primary or *secondary sidelighted areas* and shall meet not less than one of the following require- ments:

a. The combined area of the *skylights* within the *space* shall not be less than 3% of the calcu- lated *daylight area under skylights*.

b. The *space* shall have a *skylight effective aper- ture* of not less than 1%.

c. The combined area within the *space* of any *vertical fenestration* in *roof monitors* shall not be less than 20% of the calculated *daylight area under roof monitors*.

d. *Primary sidelighted areas* shall have a *side- lighting effective aperture* of not less than 0.15.

e. *Secondary sidelighted areas* shall have a *side- lighting effective aperture* of not less than 0.30.

f. The combined area of tubular daylight devices within the space shall be not less than 0.5% nor more than 2.0% of the calculated daylight area under tubular daylight devices.

801.4.1.1.2 (8.4.1.1.2) Visible Transmittance (VT) of Skylights and Roof Monitors. The visible trans- mittance of *skylights* and *roof monitors* for *daylight areas* used to comply with Section 801.4.1.1.1 (8.4.1.1.1) shall not be less than 0.15 nor higher than 0.65. For *dynamic glazing,* the highest-labeled VT shall be used for compliance with this section.

Exception: *Enclosed spaces* that have a *skylight effective aperture* of not less than 1%.

801.4.1.1.3 (8.4.1.1.3) Skylight Optical Diffusion Characteristics. *Skylights* used to comply with Sec- tion 801.4.1.1.1 (8.4.1.1.1) shall have a glazing material or diffuser that has a measured haze value

greater than 90% when tested according to ASTM D1003 or other test method approved by the *AHJ*.

Exceptions:

1. *Skylights* with a measured haze value less than or equal to 90% and having a combined area not in excess of 5% of the total *skylight* area.
2. *Tubular daylighting devices* having a diffuser.
3. *Skylights* designed to prevent direct sunlight from entering the occupied *space* below during occupied hours.
4. *Skylights* in transportation terminals and concourses, sports arenas, convention centers, atria, and shopping malls.

801.4.1.2 (8.4.1.2) Minimum Sidelighting Effective Aperture for Office Spaces and Classrooms. The *spaces* listed in Table 801.4.1.2A (8.4.1.2A) shall comply with items (a), (b) and (c).

a, The north-, south-, and east-facing façades shall have a minimum *sidelighting effective aperture* as prescribed in Table 801.4.1.2B (8.4.1.2B).

b, For all façades, the combined width of the *primary sidelighted areas* shall not be less than 75% of the length of the façade *wall*.

c. Opaque interior surfaces in *daylight areas* shall have average visible light reflectances greater than or equal to 80% for ceilings, 40% for partitions higher than 60 in. (1.5 m), and 60% for *walls*.

Exceptions:

1. *Spaces* not adjacent to an exterior *wall*.
2. A *space* that would have tasks or activities requiring routine dark conditions for more than four daytime hours per day.
3. *Spaces* covered by and in compliance with Section 801.4.1.1 (8.4.1.1) without the use of any exception.
4. *Daylight areas* where the height of existing adjacent structures above the window is not less than twice the distance between the window and the adjacent structures, measured from the top of the glazing.
5. Existing buildings undergoing alteration, repair, relocation, or a change in occupancy.

801.4.1.3 (8.4.1.3) Shading for Offices. For office *spaces* 80 ft^2 (23 m^2) and larger, each façade shall be designed with a shading *projection factor* (*PF*). The *PF* shall not be less than 0.5 for the first story above grade and 0.25 for other above-grade stories. Shading is allowed to be external . Shading devices shall be limited to the following:

a. Louvers, sun shades, light shelves, and any other permanent device. Any *vertical fenestration* that

employs a combination of interior and external shading is allowed to be separated into multiple segments for compliance purposes. Each segment shall comply with the requirements for either external .

b. Building self-shading through *roof* overhangs or recessed windows.

Exceptions:

1. Facades facing within 45 degrees of true north in the northern hemisphere or facades facing 45 degrees from true south in the southern hemisphere.
2. Translucent panels and glazing systems with a measured haze value greater than 90% when tested according to ASTM D1003 or other test method approved by the *AHJ*, and that are entirely 8 ft (2.5 m) above the floor do not require external shading devices.
3. Where equivalent shading of the *vertical fen- estration* is provided by buildings, structures, geological formations, or permanent exterior projections that are not horizontal, as deter- mined by sun-angle studies at the peak solar altitude on the summer solstice and three hours before and after the peak solar altitude on the summer solstice.
4. *Vertical fenestration* with automatically con- trolled shading devices in compliance with Exception (2) of Section 701.4.2.5 (7.4.2.5).
5. *Vertical fenestration* with automatically con- trolled *dynamic glazing* in compliance with Exception (3) of Section 701.4.2.5 (7.4.2.5).
6. Existing buildings undergoing alteration, repair, relocation, or a change in occupancy.

TABLE 801.4.1.2A (TABLE 8.4.1.2A) DAYLIT SPACES

Classroom/training room
Conference /meeting/multipurpose room except in convention centers
Lounge/breakroom
Enclosed office and open plan office
Library reading area
Patient rooms and physical therapy rooms within a healthcare facility

TABLE 801.4.1.2B (TABLE 8.4.1.2B) MINIMUM SIDELIGHTING EFFECTIVE APERTURE

CLIMATE ZONE	MINIMUM SIDELIGHTING EFFECTIVE APERTURE
0, 1, 2, 3A, 3B	0.10
3C, 4, 5, 6, 7, 8	0.15

801.4.2 **(8.4.2) Materials. (Section 801.4.2 should be moved and renumbered as mandatory Section 801.3.9)** Reported emissions or volatile organic compound (VOC) contents specified in the follow- ing subsections shall be from a representative product sample and determined with each product reformulation or at a minimum of every three years. Products certified under third-party certification programs as meeting the specific emission or VOC content requirements listed in the following subsections are exempted from this three- year testing requirement but shall meet all the other requirements as listed.

801.4.2.1 (8.4.2.1) Adhesives and Sealants. Products in this category include carpet, resilient, and wood flooring adhesives; base cove adhesives; ceramic tile adhesives; drywall and panel adhesives; aerosol adhesives; adhesive primers; acoustical sealants; firestop sealants; HVAC air duct sealants; sealant primers; and caulks. All adhesives and sealants used on the interior of the building (defined as inside of the *weatherproofing system* and applied on-site) shall comply with the requirements of either Section 801.4.2.1.1 (8.4.2.1.1) or 801.4.2.1.2 (8.4.2.1.2).

801.4.2.1.1 (8.4.2.1.1) Emissions Requirements. Emissions shall be determined according to CDPH/EHLB/Standard Method V1.1 (commonly known as California Section 01350) and shall comply with the limit requirements for either office or *classroom spaces*, regardless of the *space* type. The emissions testing shall be performed by an ISO/IEC 17025 accredited laboratory that has CDPH/EHLB/Standard Method V.1.1, USEPA Method TO-17, and ASTM Standard Method D5197 within the scope of its accreditation. Third-party certifiers shall be accredited to ISO/IEC 17065 and have the relevant certification program in the scope of accreditation.

801.4.2.1.2 (8.4.2.1.2) VOC Content Requirements. The VOC content of adhesives, sealants, and sealant primers shall be determined and limited in accordance with SCAQMD Rule 1168. HVAC duct sealants shall be classified as "Other" category within the SCAQMD Rule 1168 sealants table.

The VOC content of aerosol adhesives shall be determined and limited in accordance with Green Seal Standard GS-36, Section 3.

Exceptions: The following solvent welding and sealant products are not required to meet the emissions or VOC content requirements.

1. Cleaners, solvent cements, and primers used with plastic piping and conduit in plumbing, fire suppression, and electrical systems.
2. HVAC air-duct sealants when the air temperature of the *space* in which they are applied is less than 40°F (4.5°C).

801.4.2.2 (8.4.2.2) Paints and Coatings. Products in this category include anticorrosive coatings, basement specialty coatings, concrete/masonry sealers, concrete curing compounds, dry fog coatings, faux-finishing

coatings, fire-resistive coatings, flat and nonflat top- coats, floor coatings, graphic arts (sign) coatings, high- temperature coatings, industrial maintenance coatings, low-solids coatings, mastic texture coatings, metallic pigmented coatings, multicolor coatings, pretreatment wash primers, primers, reactive penetrating sealers, recycled coatings, shellacs (clear and opaque), spe- cialty primers, stains, stone consolidants, swimming- pool coatings, tub- and tile-refining coatings, under- coaters, waterproofing membranes, wood coatings (clear wood finishes), wood preservatives, and zinc primers. Paints and coatings used on the interior of the building (defined as inside of the *weatherproofing sys- tem* and applied on-site) shall comply with either Sec- tion 801.4.2.2.1 (8.4.2.2.1) or 801.4.2.2.2 (8.4.2.2.2).

801.4.2.2.1 (8.4.2.2.1) Emissions Requirements. Emissions shall be determined according to CDPH/ EHLB/Standard Method V1.1 (commonly known as California Section 01350) and shall comply with the limit requirements for either office or *classroom spaces*, regardless of the *space* type. The emissions testing shall be performed by an ISO/IEC 17025 accredited laboratory that has CDPH/EHLB/Stan- dard Method V.1.1, USEPA Method TO-17, and ASTM Standard Method D5197 within the scope of its accreditation. Third-party certifiers shall be accredited to ISO/IEC 17065 and have the relevant certification program in the scope of accreditation.

801.4.2.2.2 (8.4.2.2.2) VOC Content Require- ments.

a. The VOC content for flat and nonflat coatings, nonflat high-gloss coatings, specialty coat- ings, basement specialty coatings, concrete/ masonry sealers, fire-resistive coatings, floor coatings, low-solids coatings, primers, sealers and undercoaters, rust preventative coatings, shellacs (clear and opaque), stains, wood coat- ings, reflective *wall* coatings, varnishes, con- jugated oil varnish, lacquer, and clear brushing lacquer shall be determined and lim- ited in accordance with Green Seal Standard GS-11.

b. The VOC content for concrete curing com- pounds, dry fog coatings, faux finishing coat- ings, graphic arts coatings (sign paints), industrial maintenance coatings, mastic tex- ture coatings, metallic pigmented coatings, multicolor coatings, pretreatment wash prim- ers, reactive penetrating sealers, recycled coat- ings, specialty primers, wood preservatives, and zinc primers shall be determined and lim- ited in accordance with the California Air Resources Board Suggested Control Measure for Architectural Coatings or SCAQMD Rule 1113r.

c. The VOC content for high- temperature coat- ings, stone consolidants, swimming-pool coat- ings, tub- and tile-refinishing coatings, and waterproofing membranes shall be determined

and limited in accordance with the California Air Resources Board Suggested Control Measure for Architectural Coatings.

801.4.2.3 (8.4.2.3) Floor Covering Materials. Emissions of floor covering materials installed in the building interior, and each product layer within a flooring system containing more than one distinct product layer, shall be individually determined according to CDPH/EHLB/Standard Method V1.1 (commonly known as California Section 01350) and shall comply with the limit requirements for either office or *classroom spaces*, regardless of the *space* type. The emissions testing shall be performed by an ISO/IEC 17025 accredited laboratory that has CDPH/EHLB/Standard Method V.1.1, USEPA TO-17, and ASTM Standard Method D5197 within the scope of its accreditation. Third-party certifiers shall be accredited to ISO/IEC 17065 and have the relevant certification program in the scope of accreditation.

801.4.2.3.1 (8.4.2.3.1) Deemed to Comply. Floor covering materials that are composed of materials listed in Table 801.4.2.3.1 (8.4.2.3.1) shall be deemed to comply with the requirements of Section 801.4.2.3 (8.4.2.3). Where these products include integral organic-based surface coatings, binders, or sealants, or are installed using adhesives, sealants, paints, or coatings, those products shall be subject to other requirements of Section 801.4.2 (8.4.2).

TABLE 801.4.2.3.1 (TABLE 8.4.2.3.1)
FLOOR COVERING DEEMED TO COMPLY WITH VOC EMISSION LIMITS

Ceramic and concrete tile
Natural stone
Gypsum plaster
Clay masonry
Concrete masonry
Concrete
Metal

801.4.2.4 (8.4.2.4) Composite Wood, Wood Struc- tural Panel, and Agrifiber Products. Composite wood, wood structural panel, and agrifiber products used on the interior of the building (defined as inside of the *weatherproofing system*) shall contain no added urea-formaldehyde resins. Laminating adhe- sives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall con- tain no added urea-formaldehyde resins. Composite wood and agrifiber products are defined as follows: particleboard, medium density fiberboard (MDF), wheatboard, strawboard, panel substrates, and door cores. Materials considered furniture, fixtures, and equipment (FF&E) are not considered base building elements and are not included in this requirement.

Emissions for products covered by this section shall be determined according to, and shall comply with, one of the following:

a. Third-party certification shall be submitted indicating compliance with the California Air Resource Board's (CARB) regulation, *Air- borne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products.* Third-party certifier shall be approved by CARB.

b. CDPH/EHLB/Standard Method V1.1 (com- monly referred to as California Section 01350) and shall comply with the limit requirements for either office or *classroom spaces*, regard- less of the *space* type.

Exceptions: Structural panel components such as plywood, particle board, wafer board, and ori- ented strand board identified as "EXPOSURE 1," "EXTERIOR," or "HUD-APPROVED" are con-
sidered acceptable for interior use.

801.4.2.5.1

801.4.3 **(8.4.3) Lighting for Presentations.** Luminaires that are located entirely or partially within 3 ft (0.9 m) horizontally of any *permanently installed* presentation surfaces, including whiteboards, blackboards, chalkboards, and screens for projection units, shall be controlled separately from all other luminaires in the *space* and be capable of being turned off. Control settings for these luminaires shall be labeled at the control device. At least one luminaire shall be located entirely or partially within 3 ft (0.9 m) horizontally of each *permanently installed* whiteboard, blackboard, or chalkboard that is not self-illuminated.

801.5 (8.5) Performance Option.

801.5.1 (8.5.1) Daylight Simulation. For the *spaces* listed in Table 801.4.1.2A (8.4.1.2A), and any *spaces* required to have daylighting in accordance with Section 801.4.1.1 (8.4.1.1), the total floor area shall be calculated, and computer modeling shall be used to determine that the requirements specified in Sections 801.5.1.1 (8.5.1.1) and 801.5.1.2 (8.5.1.2) are met. Computer models shall use an hourly simulation and shall adhere to the modeling protocols described in IES LM 83 for *spatial daylight autonomy* (*sDA*) calculations in Section 801.5.1.1 (8.5.1.1) and *annual sunlight exposure* (*ASE*) calculations in Section 801.5.1.2 (8.5.1.2).

801.5.1.1 (8.5.1.1) Minimum Daylight. The computed area-weighted *sDA* shall not be less than 40%.

The *sDA* within each *space* shall be calculated in accordance with the methodology of IES LM 83. Cal- culations shall be made on the basis of 28 fc (300 lux) for all *spaces*, with the exception of the following *space* types, which shall be calculated on the basis of 14 fc (150 lux): health-care patient rooms, post-office sorting areas, gymnasia, big box retail, transportation facility terminal ticket counters, airport concourses, and nonrefrigerated warehouses.

Exceptions:

1. A *space* used for tasks or activities requiring routine dark conditions for more than 4 day- time hours per day.
2. A *space* where the height of existing facing structures above the *vertical fenestration* is not less than twice the distance between the *vertical fenestration* and facing structures, measured from the top of the glazing.

801.5.1.2 (8.5.1.2) Excessive Sunlight. The *ASE*, cal- culated with a threshold of 93 fc (1000 lux) and 250 hours, shall not exceed 20% of the floor area.

Exceptions:

1. Spaces less than 250 ft^2 (23 m^2).
2. *Vertical fenestration* with automatically con- trolled shading devices in compliance with Section 701.4.2.5 (7.4.2.5), Exception (2).
3. *Vertical fenestration* with automatically con- trolled *dynamic glazing* in compliance with Section 701.4.2.5 (7.4.2.5), Exception (3).

801.5.2 **(8.5.2) Materials.** The emissions of all the materials listed below and used within the building (defined as inside of the *weatherproofing system* and applied on-site) shall be modeled for individual VOC concentrations. The sum of each individual VOC con- centration from the materials listed below shall be shown to be in compliance with the limits as listed in CDPH/EHLB/Standard Method V1.1 (commonly referred to as California Section 01350), Section 4.3, and shall be compared to 100% of its corresponding listed limit. In addition, the modeling for the building shall include, at a minimum, the criteria listed in Nor- mative Appendix D of this code. Emissions of materi- als used for

modeling VOC concentrations shall be obtained in accordance with the testing procedures of CDPH/EHLB/Standard Method V1.1 unless otherwise noted below.

a. Tile, strip, panel, and plank products, including vinyl composition tile, resilient floor tile, lino- leum tile, wood floor strips, parquet flooring, laminated flooring, and modular carpet tile.

b. Sheet and roll goods, including broadloom car- pet, sheet vinyl, sheet linoleum, carpet cushion, wallcovering, and other fabric.

c. Rigid panel products, including gypsum board, other *wall* paneling, insulation board, oriented strand board, medium density fiber board, wood structural panel, acoustical ceiling tiles, and particleboard.

d. Insulation products.

e. Containerized products, including adhesives, sealants, paints, other coatings, primers, and other "wet" products.

f. Cabinets, shelves, and worksurfaces that are permanently attached to the building before occupancy. Emissions of these items shall be obtained in accordance with the ANSI/BIFMA M7.1.

g. *Office furniture systems* and *seating* installed prior to initial occupancy. Emissions of these items shall be obtained in accordance with the BIFMA M7.1.

Exception: *Salvaged materials* that have not been refurbished or refinished within one year prior to installation.

801.5.3 (8.5.3) Lighting for Presentations. Lighting systems shall be provided and shall be controllable by the occupants so as to meet the illuminance and uniformity requirements specified in items (a) through (c) for each *permanently installed* presentation system. Lighting con- trol settings required to meet each of the specified levels shall be labeled at the control device.

a. Lighting system and controls shall be capable of illuminating *permanently installed* white boards to at least an average of 28 fc (300 lux) vertical illumi- nance, and the ratio of average-to-minimum illuminance over the full area of the whiteboard shall be equal to or less than 3:1.

b, Lighting system and controls shall be capable of illuminating *permanently installed* screens for front- screen projection units to no greater than 5 fc (50 lux) vertical illuminance, and the ratio of maximum- to-average illuminance over the full area of the pro- jection screen shall be equal to or less than 2:1. Compliance with this provision shall not be met by turning off all the luminaires in the *space*.

c, Lighting system and controls shall be capable of illuminating *permanently installed* screens for rear- screen projection units at a level no greater than 14 fc (150 lux) vertical illuminance, and the ratio of maximum-to-average illuminance over the full area of the projection screen shall be equal to or less than 2:1. Compliance with this provision shall not be met by turning off all the luminaires in the *space*.

CHAPTER 9

MATERIALS AND RESOURCES

901.1 (9.1) Scope. This section specifies requirements related to the environmental and human health impacts of materials, including resource conservation, reduced life-cycle impacts of building materials, impacts on the atmosphere, product transparency, and waste management.

901.2 (9.2) Compliance. The building materials shall comply with Section 901.3 (9.3), "Mandatory Provisions" in accordance with Section 101.4.1, and either

a. Section 901.4 (9.4), "Prescriptive Option," or

b. Section 901.5 (9.5), "Performance Option."

901.3 (9.3) Mandatory Provisions.

901.3.1 (9.3.1) Construction Waste Management.

901.3.1.1 (9.3.1.1) Diversion. A minimum of 50% of nonhazardous construction and demolition waste material generated prior to the issuance of the final certificate of occupancy shall be diverted from disposal in landfills and incinerators by reuse, recycling, repurposing, and/or composting. Excavated soil and land-clearing debris shall not be included in the waste diversion calculation. *Alternative daily cover* and waste-to-energy incineration shall not be included as diverted material. All diversion calculations shall be based on either weight or volume, but not both, throughout the construction process.

Informative Note: Reuse includes donation of materials to charitable organizations; salvage of existing materials on-site; reclamation of products by manufacturers; and return of packaging materials to the manufacturer, shipper, or other source for reuse as packaging in future shipments.

901.3.1.2 (9.3.1.2) Reserved

901.3.1.3 (9.3.1.3) Construction Waste Management Plan. Prior to issuance of a demolition or building permit, a preconstruction waste management plan shall be submitted to the *owner*. The plan shall:

a. identify the construction and demolition waste materials expected to be diverted,

b. determine whether construction and demolition waste materials are to be source-separated or commingled,

c. identify service providers and designate destina- tion facilities for construction and demolition waste materials generated at the job *site*, and

d. identify the average diversion rate for facilities that accept or process commingled construction and demolition materials. Separate average per- centages shall be included for those materials collected by construction and demolition materials processing facilities that end up as *alternative daily cover* and incineration.

e. Signage in English and Spanish

f. Training for all employees on proper disposal of materials

901.3.1.4 (9.3.1.4) Construction Waste Documentation. The following documentation of disposal shall be provided:

a. A spreadsheet documenting the weight of each material diverted from the landfill and the overall diversion rate filled out by the waste hauler.

b. Photos of all dumpsters

c.

901.3.2 (9.3.2) Reserved(9.3.3) Refrigerants. Chlorofluorocarbon (CFC) and hydrochlorofluorocarbons (HCFC) based refrigerants in HVAC&R systems shall not be used. Fire suppression systems shall not contain ozone-depleting substances (CFCs, hydrochlorofluorocarbons [HCFCs], or halons). For existing buildings with HVAC&R systems containing CFCs or HCFCs, a plan shall be submitted to the *building official* for phasing out all CFC and HCFC usage in the *building*.

901.3.2.1 (9.3.4.1) Recyclables. There shall be recyclable areas that serve the entire building and are dedicated to the collection and storage of

nonhazardous materials for recycling, including paper, corrugated cardboard, glass, plastics, and metals.

901.3.2.2 (9.3.4.2) Reserved

901.3.2.3 (9.3.4.3) Reserved

901.3.2.4 (9.3.4.4) Reserved

901.3.2.5 (9.3.5) Mercury Content Levels of Lamps. Electric lamps used in the *building project*

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shall not contain mercury in an amount exceeding, per lamp, the maximum mercury content levels of Table 901.3.5 (9.3.5).

Exceptions:

1. Eight-foot models of straight fluorescent T8 lamps.
2. High-output and very-high-output, straight fluorescent lamps greater than 1.25 in. (32 mm) in diameter.
3. Mogul bi-pin-based lamps.
4. Preheat straight fluorescent lamps of any size.
5. U-bend and circline fluorescent lamps.
6. HID lamps.
7. Induction lamps.
8. Special-purpose lamps: appliance, black light, germicidal, bug, colored, grow, straight fluorescent reflector, reprographic, shatter resis- tant, cold temperature, and three-way lamps.
9. LED lamps

;

901.4 (9.4) Prescriptive Option.

901.4.1 (9.4.1) Reduced Impact Materials. The *building project* shall comply with any two of the following: Sec- tions 901.4.1.1, 901.4.1.2. 901.4.1.3, or 901.4.1.4 (9.4.1.1, 9.4.1.2, 9.4.1.3, or 9.4.1.4). Calculations shall only include materials *permanently installed* in the project. A value of 45% of the total construction cost shall be permitted to be used in lieu of the actual total cost of materials.

901.4.1.1 **(9.4.1.1) Recycled Content and Salvaged Material Content.** The sum of the *recycled content* and the *salvaged material* content shall constitute a minimum of 10%, based on cost, of the total materials in the *building project.*

901.4.1.1.1 (9.4.1.1.1) Recycled Content. The *recy- cled content* of a material shall be the *postconsumer recycled content* plus one-half of the *preconsumer recycled content*, determined by weight (mass). The recycled fraction of the material in a product or an assembly shall then be multiplied by the cost of the product or assembly to determine its contribution to the 10% requirement.

The annual average industry values, by country of production, for the *recycled content* of steel prod- ucts manufactured in basic oxygen furnaces and electric arc furnaces shall be permitted to be used as the *recycled content* of the steel. For the purpose of calculating the *recycled content* contribution of con- crete, the constituent materials in concrete (***Infor- mative Note:*** e.g., the cementitious materials, aggregates, and water) shall be permitted to be treated as separate components and calculated sepa- rately.

901.4.1.1.2 (9.4.1.1.2) Salvaged Material Content. The *salvaged material* content shall be determined based on the actual cost of the *salvaged material* or the cost of a comparable alternative component material.

901.4.1.2 **(9.4.1.2) Regional Materials.** A minimum of 10%of building materials or products used, based on cost, shall be regionally extracted/harvested/recovered or manufactured within a radius of 600 mi (960 km) of the project *site.* If only a fraction of a product or material is extracted/harvested/recovered or manufactured locally, then only that percentage (by weight) shall con- tribute to the regional value.

Exception: For building materials or products shipped in part by rail or water, the total distance to the project shall be determined by weighted average, whereby that portion of the distance shipped by rail or water shall be multiplied by 0.25 and added to that portion not shipped by rail or water, provided that the total does not exceed 600 mi (960 km).

901.4.1.3 **(9.4.1.3) Biobased Products.** A minimum of 5% of building materials used, based on cost, shall be *biobased product*s. *Biobased products* shall:

a. comply with the minimum biobased contents of the USDA's BioPreferred Program;

b. contain the "USDA Certified *Biobased Product*" label; or

c. be composed of solid wood, engineered wood, bamboo, wool, cotton, cork, agricultural fibers, or other biobased materials with at least 50% biobased content.

901.4.1.3.1 (9.4.1.3.1) Wood Building Compo- nents. Wood building components, including but not limited to structural framing, sheathing, flooring, subflooring,

;

wood window sash and frames, doors, and architectural millwork, used to comply with this requirement shall contain not less than 60% certified wood content tracked through a chain of custody process, either by physical separation or percentage- based approaches, or wood that qualifies as a *salvaged material*. Certified wood content documenta- tion shall be provided by sources certified through a forest certification system with principles, criteria, and standards developed using ISO/IEC Guide 59 or the WTO Technical Barriers to Trade. Wood build- ing components from a *vendor* shall be permitted to

;

TABLE 901.3.5 (TABLE 9.3.5)
MAXIMUM MERCURY CONTENT FOR ELECTRIC LAMPS

LAMP	MAXIMUM MERCURY CONTENT
Screw-base compact fluorescent lamps < 25 W	4 mg
Screw-base compact fluorescent lamps ≥ 25 W and < 40 W	5 mg
Pin-base compact fluorescent lamps, all wattages	5 mg
Straight fluorescent T5 normal lifetime lamps [a]	3 mg
Straight fluorescent T8 normal lifetime lamps [a]	4 mg
Straight fluorescent T5 and T8 long lifetime lamps [b]	5 mg
T12 eight-foot straight fluorescent lamps	15 mg

a. Electric lamps with a rated lifetime less than 25,000 hours when tested on an electronic fluorescent ballast, including T8 instant-start ballasts and T5 programmed-start ballasts, and turned OFF and ON every three hours.

b. Electric lamps with a rated lifetime equal to or greater than 25,000 hours when tested on an electronic fluorescent ballast, including T8 instant-start ballasts and T5 programmed-start ballasts, and turned OFF and ON every three hours.

complywhen the annual average amount of certified wood products purchased by the *vendor*, for which they have chain of custody *verification* not older than two years, is 60% or greater of their total annual wood products purchased.

901.4.1.4 (9.4.1.4) Multiple-Attribute Product Declaration or Certification. A minimum of ten different products installed in the *building project* at the time of issuance of certificate of occupancy shall comply with one of the following subsections. Declarations, reports, and assessments shall be submitted to the *authority having jurisdiction* (*AHJ*) and shall contain documentation of the critical peer review by an independent third party, results from the review, the reviewer's name, company name, contact information, and date of the review or certification.

901.4.1.4.1 (9.4.1.4.1) Industry-Wide Declaration. A Type III industry-wide environmental product declaration (EPD) shall be submitted for each prod- uct. Where the program operator explicitly recog- nizes the EPD as fully representative of the product group on a national level, it is considered industry- wide. In the case where an industry-wide EPD rep- resents only a subset of an industry group, as opposed to being industry-wide, the manufacturer shall be explicitly recognized as a participant by the EPD program operator. All EPD shall be consistent with ISO Standards 14025 and 21930, with at least a cradle-to-gate scope. Each product complying with this section shall be counted as one product for compliance with Section 901.4.1.4 (9.4.1.4).

901.4.1.4.2 (9.4.1.4.2) Product-Specific Declaration. A product-specific Type III EPD shall be submitted for each product. The product-specific declaration shall be manufacturer-specific for a product family. Type III EPDs shall be certified as complying with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930. Each product complying with this section shall be counted as two products for compli- ance with Section 901.4.1.4 (9.4.1.4).

;

901.4.1.4.3 (9.4.1.4.3) Third-Party Multiattribute Certification. A material-specific assessment shall be submitted for each product in accordance with one of the following standards, where applicable. The assessment shall be certified as meeting the minimum performance level specified in each stan- dard. Each product complying with this section shall be counted as two products for compliance with Section 901.4.1.4 (9.4.1.4).

a. ANSI/BIFMA e3
b. NSF/ANSI 140
c. NSF/ANSI 332
d. NSF/ANSI 336
e. NSF/ANSI 342
f. NSF/ANSI 347
g. NSC 373
h. ANSI A138.1
i. UL 100
j. UL 102

901.4.1.4.4 (9.4.1.4.4) Product Life Cycle. A report by a third-party that has critically reviewed the *life- cycle assessment* (*LCA*) of a product, based on ISO Standards 14040 and 14044, shall be submitted. The report shall demonstrate compliance with the goal and scope for the cradle-to-gate requirements. Each product complying with this section shall be counted as two products for compliance with Section 901.4.1.4 (9.4.1.4).

901.5 (9.5) Performance Option

901.5.1 (9.5.1) Life-Cycle Assessment (LCA). An *LCA* shall be performed in accordance with ASTM E2921 and ISO Standard 14044, as modified by this section, for a minimum of two building alternatives, both of which shall conform to the *owner's project requirements* (*OPR*).

901.5.1.1 (9.5.1.1) LCA Performance Metric. The *LCA* shall demonstrate that the final building design achieves one of the following minimum improvements over the reference building design assessed in the *LCA*:

;

a. Ten percent (10%) improvement in a minimum of each of two impact categories, one of which must be global warming.

b. Five percent (5%) improvement in a minimum of each of three impact categories, one of which must be global warming.

The following impact categories shall be used to determine compliance with this section and shall be included in the report described in Section 901.5.1.3 (9.5.1.3): land use, resource use, global warming, ozone layer depletion, human health effects, ecotoxicity, smog, acidification, and eutrophication.

901.5.1.2 (9.5.1.2) Procedure. The *LCA* shall be performed in accordance with the service lives, life-cycle stages, study boundaries, and comparison methodologies of ASTM E2921 with the following modifications:

a. Each building alternative shall comply with Chapters 6, 7 and 8 (Sections 6, 7, and 8) of this code.

b. The service life of the buildings shall not be less than that determined using Table 1001.3.2.3 (10.3.2.3), except that the service life of long-life buildings shall be no less than 75 years.

c. Operating energy consumption shall be included or excluded at the discretion of the project team.

d. The LCA tool (or tools) or software shall include a published third-party impact indicator method.

e. The estimate of structural system material quanti- ties shall be verified by a *design professional* or other approved source.

901.5.1.3 (9.5.1.3) Reporting. A report that includes a description of the building alternatives and their physi- cal differences shall be prepared and shall comply with the reporting requirements stated in ASTM E2921. The name and address of the *design professional* or other approved source verifying structural system material quantities shall be included. A critical review shall be performed by an external expert independent of those performing the *LCA*.

The report shall be submitted to the *AHJ* and include documentation of critical peer review by a third party, results from the review, and the reviewer's name and contact information.

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CHAPTER 10

CONSTRUCTION AND PLANS FOR OPERATION

1001.1 (10.1) Scope. This section specifies requirements for construction and plans for operation, including the *commissioning (Cx) process*, building *functional and performance testing* (*FPT*), measurement and *verification* (M&V), energy use reporting, durability, transportation management, erosion and sediment control, construction, and indoor air quality (IAQ) during construction.

1001.2 (10.2) Compliance. *Building projects* shall comply with Section 1001.3 in accordance with Section 101.4.1.

1001.3 (10.3) Mandatory Provisions.

1001.3.1 (10.3.1) Construction.

1001.3.1.1 (10.3.1.1) Building Systems FPT. *Functional and performance testing* shall be performed on all building systems specifically referenced in this section using *generally accepted engineering standards* acceptable to the *authority having jurisdiction* (*AHJ*).

An *FPT* process and system performance requirements shall be incorporated into *construction documents* and construction schedule of the *building project* to verify system performance.

1001.3.1.1.1 (10.3.1.1.1) FPT Requirements. An *FPT* process shall be performed for the following:

a. Heating, ventilating, air conditioning, and refrigeration systems (mechanical and passive) and associated controls that exceed total system capacities of 180,000 Btu/h (53,000 W) for cooling, 300,000 Btu/h (88,000 W) for heating, or 10,000 cfm (5000 L/s) for ventilation.

b. Lighting systems over 5 kW in total capacity, including *automatic* and daylighting controls, manual daylighting controls, occupancy-sensing devices, time switching, and *automatic* shut-off controls.

c. Domestic water-heating systems rated at over 50,000 Btu/h (15,000 W).

d. Water pumping and mixing systems over 5 hp (4 kW).

e. Irrigation systems that use more than 220,000 gal (880,000 L) per irrigation season.

1001.3.1.1.1.1 (10.3.1.1.1.1) Activities Prior to Building Permit for Facilities Using the FPT Process. The following activities shall be completed before a permit is issued for any system requiring *FPT*:

a. Designate *FPT providers*. For systems that are required to comply with Section 1001.3.1.1.1 (10.3.1.1.1), *FPT providers* shall be *owner's* qualified employees, independent commissioning (*Cx*) *providers*, or qualified designers experienced with *FPT* on the designated systems. *FPT providers* shall be independent of the building system design and construction function and shall possess the necessary experience and test- ing equipment.

b. *FPT providers* shall review the *construction documents* to verify that the relevant sensor locations, devices, and control sequences are properly specified; performance and testing criteria are included; and equipment to be tested is accessible for testing and maintenance.

1001.3.1.1.1.2 (10.3.1.1.1.2) Activities Prior to Building Occupancy for Facilities Using the FPT Process. Before issuance of a certificate of occupancy, the *FPT providers* shall complete the following activities:

a. Installation and startup of the specified sys- tems shall be verified.

b. *FPT* of systems shall be verified.

Exception: Systems for which operation is seasonally dependent, and which can- not be fully commissioned in accordance with the *commissioning (Cx) plan* at the time of occupancy, shall be commis- sioned at the earliest operation time, postoccupancy, as determined by the *FPT providers*.

c. The preparation of operation and mainte- nance (O&M) documentation and warranty information shall be verified. O&M docu- mentation, including the information needed to understand, operate, and main- tain the building systems, shall be provided to the building *owner* and facility manager.

1001.3.1.1.1.3 (10.3.1.1.1.3) Documentation. The completed project design and *FPT* documen- tation shall be provided to the *owner* and shall be retained with the project records.

1001.3.1.1.2 (10.3.1.1.2) Acoustical Control.

1001.3.1.1.2.1 (10.3.1.1.2.1) Acoustical Field Measurement. Where required by

Chapter 8 (Section 8), the *FPT* specified in Sections 1001.3.1.1.2.1.1 (10.3.1.1.2.1.1) through 1001.3.1.1.2.1.2 (10.3.1.1.2.1.2) shall be completed.

1001.3.1.1.2.1.1 (10.3.1.1.2.1.1) Interior Background Sound Levels. The interior sound level shall be measured in accordance with ANSI S12.72 using a sound level meter

in slow-response setting as defined in ANSI/ ASA S1.4. The testing shall include not less than 10% of the rooms of each type specified in Table 801.3.3.2 (8.3.3.2) that has a prescribed maximum *hourly average sound pressure level* L_{eq} dBA of 40 or less. The measured performance of the *spaces* shall not exceed the values specified in Table 801.3.3.2 (8.3.3.2) by greater than 5 dBA or 5 dBC.

1001.3.1.1.2.1.2 (10.3.1.1.2.1.2) Interior

Sound Transmission. The testing of interior sound transmission shall be in accordance with ASTM E336 with respect to noise isolation class (NIC) and ASTM E1007 with respect to impact sound rating (ISR). Tested NIC values shall not be more than five less than the composite sound transmission class (cSTC) values, and the ISR values shall not exceed 5 less than the impact insulation class (IIC) values in Table 801.3.3.3 (8.3.3.3). Testing shall be performed on not less than 10% of the partitions between rooms of each type in Table 801.3.3.3 (8.3.3.3) that has a prescribed cSTC or IIC of 50 or higher.

1001.3.1.1.2.1.3 (10.3.1.1.2.1.3) Property

Line Sound. Testing shall be performed at the locations and times of day or night that are estimated to most likely result in failure and shall be performed with all equipment operating under normal 100% load operation. If daytime test results comply with the nighttime requirements, nighttime testing is not required. The testing shall be in accordance with ANSI/ASA S1.13. The testing results shall comply with the property line noise levels in Table 801.3.3.5.2 (8.3.3.5.2). At the discretion of the *AHJ*, noise that is not created on the source property need not be included in the reported test results.

1001.3.1.2 (10.3.1.2) Building Project Commissioning (Cx) Process. The *Cx process* shall be performed in accordance with this section using ANSI/ASHRAE/ IES Standard 202 or other *generally accepted engineering standards* acceptable to the *AHJ*. The *Cx provider* shall verify that a *Cx process* has been incorporated into the design phases of the project and that commissioning shall be incorporated into the *construction documents.* The *Cx process* documents that the building and its commissioned components, assemblies, and systems comply with the *owner's project requirements* (*OPR*). The project requirements, including *OPR*, *BoD*, design and construction record documentation, training plans and records, O&M plans and procedures, and Cx reports shall be assembled in a systems manual that provides information for building operating and mainte- nance staff.

1001.3.1.2.1 (10.3.1.2.1) Systems to be Commis- sioned. For buildings that exceed 10,000 ft^2 (1000 m^2) of gross floor area, the *Cx process* shall be included in the design and construction of the *build- ing project*. The following systems and associated controls, where included in the *building project*, shall be commissioned:

a. Heating, ventilating, air-conditioning, and refrigeration systems (mechanical and/or pas- sive) and associated controls.

b. Air-curtain systems.

c. Lighting systems: *automatic* and manual daylighting controls, occupancy sensing devices, *automatic* shut-off controls, time switching, and other lighting control devices, and dimming systems claiming a lighting power allowance for institutional tuning according to Section 701.4.6.1.1(f) [7.4.6.1.1(f)].

d. Domestic hot-water systems and controls.

e. Water pumping and mixing systems over 5 hp (4kW) and purification systems.

f. Irrigation system performance that uses more than 1000 gal (4000 L) per day.

g. Renewable energy systems and energy storage systems.

h. Energy and building management and demand-control systems.

1001.3.1.2.2 (10.3.1.2.2) Cx Activities Prior to Building Permit. The following activities shall be completed prior to issuance of a building permit:

a. A copy of the *Cx plan* in accordance with ANSI/ASHRAE/IES Standard 202 shall be submitted for review with the building permit application.

b. An *approved Cx provider* shall be desig- nated by the *owner* to manage *Cx process* activities prior to completion of *construction documents*. The *Cx provider* shall have the necessary training, experience, and equip- ment and be independent from the design team and the contractor responsible for the work being commissioned. The *Cx provider* shall disclose possible conflicts of interest so that objectivity can be confirmed. The Cx team shall include an *FPT provider* who may also be the *Cx provider*.

c. Construction phase Cx requirements shall be incorporated into project specifications and other *construction documents* developed by the design team.

1001.3.1.2.3 (10.3.1.2.3) Cx Activities Prior to Building Occupancy. The following activities shall

be completed prior to issuance of a certificate of occupancy:

a. For the systems being commissioned, verify that commissioning has been completed, installation has been verified, *FPT* has been performed, and that reporting includes documentation of test results.

Exception: Systems for which operation is seasonally dependent and which cannot be fully commissioned in accordance with the *Cx plan* at the time of occupancy shall be commissioned at the earliest operation time, postoccupancy, as determined by the *Cx provider*.

b. The *owner* shall be provided with a preliminary Cx report per compliance with Section 1001.3.1.3 (10.3.1.3). A copy of the Cx preliminary report shall be submitted to the *AHJ* upon request.

c. The *Cx provider* shall verify that the *owner* has been provided with a systems manual that includes the information needed to understand and operate the commissioned systems as designed, including warranty information for the commissioned systems. The systems manual with design and operational information shall be available for building operator and maintenance training.

1001.3.1.2.4 (10.3.1.2.4) Postoccupancy Cx Activi- ties. The *Cx plan* shall contain postoccupancy Cx requirements in accordance with ANSI/ASHRAE/ IES Standard 202. The *Cx provider* shall provide the *owner* with a complete systems manual, all record documents, and a complete final Cx report in accor- dance with Standard 202.

1001.3.1.3 (10.3.1.3) Project Cx Documents

1001.3.1.3.1 (10.3.1.3.1) Cx Plan. A *Cx plan* shall be developed by a *Cx provider* in accordance with ANSI/ASHRAE/IES Standard 202 for all systems to be commissioned and/or tested.

1001.3.1.3.2 (10.3.1.3.2) Design Review Report. The *Cx provider* shall provide to the *owner* and design teams a Cx design review report that complies with ANSI/ASHRAE/IES Standard 202 and details compliance with the *OPR*. This Cx design review shall not be considered a design peer review or a code or regulatory review.

1001.3.1.3.3 (10.3.1.3.3) Preliminary Cx Report. The *Cx provider* shall provide a preliminary Cx report that includes the following information:

a. Performance of commissioned equipment, systems, and assemblies;

b. Issue and resolution logs, including itemization of deficiencies found during testing and commissioning that have not been corrected at the time of report preparation;

c. Deferred tests that cannot be performed at the time of report preparation;

d. Documentation of the training of operating personnel and building occupants on commis- sioned systems and a plan for the completion of any deferred trainings that were unable to be fully commissioned at the time of report preparation; and

e. A plan for the completion of commissioning, including climatic and other conditions required for performance of the deferred tests.

1001.3.1.3.4 (10.3.1.3.4) Final Cx Report. The *Cx provider* shall provide to the *owner*, prior to project completion, a final Cx report that complies with ANSI/ASHRAE/IES Standard 202.

1001.3.1.3.5 (10.3.1.3.5) Reserved

1001.3.1.3.6 (10.3.1.3.6) Documentation. *Owner* shall retain the systems manual and final Cx report.

1001.3.1.4 (10.3.1.4) Erosion and Sedimentation Control (ESC). Develop and implement an ESC plan

for all construction activities. The ESC plan shall conform to the erosion and sedimentation control requirements of the most current version of the USEPA NPDES General Permit for Stormwater Discharges from Construction Activities, or local erosion and sedimentation control standards and codes, whichever is more stringent, and regardless of size of project.

1001.3.1.5 (10.3.1.5) IAQ Construction Management. Develop and implement an IAQ construction management plan to include the following:

a. Air conveyance materials shall be stored and covered so that they remain clean. All filters and controls shall be in place and operational when HVAC systems are operated during building flush-out or baseline IAQ monitoring. Except for system startup, testing, balancing, and commissioning, permanent HVAC systems shall not be used during construction.

b. After construction ends, prior to occupancy and with all interior finishes installed, a postconstruction, preoccupancy building flush-out as described under Section 1001.3.1.5(b)(1) [10.3.1.5(b)(1)], or postconstruction, preoccupancy baseline IAQ monitoring as described under Section 1001.3.1.5(b)(2) [10.3.1.5(b)(2)], shall be performed:

1. **Postconstruction, preoccupancy flush-out.** A total air volume of *outdoor air* in total air changes as defined by Equation 10-1 shall be supplied while maintaining an internal temperature of a minimum of 60°F (15°C) and relative humidity no higher than 60%. For buildings located in nonattainment areas, filtration and/or air cleaning as described in Section 801.3.1.3 (8.3.1.3) shall be supplied when the Air Quality Index forecast exceeds 100 (category orange, red, purple, or maroon). One of the following options shall be followed:

   i. **Continuous postconstruction, preoccupancy flush-out.** The flush-out shall be continuous and supplied at an outdoor airflow rate no lessthan that determined in Section 801.3.1.1 (8.3.1.1).

   ii. Continuous postconstruction, preoccupancy/postoccupancy flush-out. If occupancy is desired prior to completion of the flush-out, the *space* is allowed to be occupied whichever is greater. These conditions shall be maintained until the total air changes calculated according to Equation 10-1 have been delivered to the *space*. The flush-out shall be continuous.

$$TAC = V_{ot} \times \frac{1}{\overline{A}} \times \frac{1}{\overline{H}} \times 60 \text{ min/h} \times 24 \text{ h/day} \times 14 \text{ days} \quad \text{(I-P)}$$

$$TAC = V_{ot} \times \frac{1 \text{ m}^3}{1000L} \times \frac{1}{\overline{A}} \times \frac{1}{\overline{H}} \times 3600 \text{ s/h} \times 24 \text{ h/day} \times 14 \text{ days} \quad \text{(SI)}$$

(Equation 10-1)

where:

TAC = total air changes.

following delivery to the *space* of half of the total air changes calculated from Equation 10-1. The *space* shall be ventilated at a minimum rate of 0.30 cfm per ft^2 (1.5 L/s per m^2) of *outdoor air*, or the outdoor airflow rate determined in Section 801.3.1.1 (8.3.1.1),

V_{ot} = system design *outdoor air* intake flow, cfm (L/s) (according to ANSI/ASHRAE Standard 62.1).

A = floor area, ft^2 (m^2).

H = ceiling height, ft (m).

2. **Postconstruction, preoccupancy base- line IAQ monitoring.** Baseline IAQ test- ing shall be conducted after construction ends and prior to occupancy. The ventila- tion system shall be operated continuously, within ±10% of the outdoor airflow rate provided by the ventilation system at design occupancy, for a minimum of 24 hours prior to IAQ monitoring. Testing shall be performed using protocols consis- tent with the USEPA Compendium of Methods for the Determination of Toxic Organic Pollutants in Ambient Air, TO-1, TO-11, TO-17, and ASTM Standard Method D 5197. The testing shall demon- strate that the *contaminant* maximum con- centrations listed in Table 1001.3.1.5 (10.3.1.5) are not exceeded in the return airstreams of the HVAC systems that serve the *space* intended for occupancy. If the return airstream of the HVAC system serv- ing the *space* intended for occupancy can- not be separated from other *spaces*, then for each portion of the building served by a separate ventilation system, the testing shall demonstrate that the *contaminant* maximum concentrations at *breathing zone* listed in Table 1001.3.1.5 (10.3.1.5) are not exceeded in the larger of the following number of locations: (i) no fewer than one location per 25,000 ft^2 (2500 m^2) or (ii) in each contiguous floor area. For each sam- pling point where the maximum concentra- tion limits are exceeded, conduct additional

TABLE 1001.3.1.5 (TABLE 10.3.1.5) MAXIMUM CONCENTRATION OF AIR POLLUTANTS RELEVANT TO IAQ

CONTAMINANT	MAXIMUM CONCENTRATION, µg/m³ (UNLESS OTHERWISE NOTED)
Nonvolatile Organic Compounds	
Carbon monoxide (CO)	9 ppm and no greater than 2 ppm above outdoor levels
Ozone	0.075 ppm (8-h)
Particulates (PM2.5)	35 (24 h)
Particulates (PM10)	150 (24 h)
Volatile Organic Compounds	
Acetaldehyde	140
Acrylonitrile	5
Benzene	60
1,3-butadiene	20
t-butyl methyl ether (methyl-t-butyl ether)	8000
Carbon disulfide	800
Caprolactam [a]	100
Carbon tetrachloride	40
Chlorobenzene	1000
Chloroform	300
1,4-dichlorobenzene	800
Dichloromethane (methylene chloride)	400
1,4-Dioxane	3000
Ethylbenzene	2000
Ethylene glycol	400
Formaldehyde	33
2-Ethylhexanoic acid [a]	25
n-Hexane	7000
1-methyl-2-pyrrolidinone [a]	160
Naphthalene	9
Nonanal [a]	13
Octanal [a]	7.2
Phenol	200
4-phenylcyclohexene (4 PCH) [a]	2.5
2-propanol (isopropanol)	7000
Styrene	900
Tetrachloroethene (tetrachloroethylene, perchloroethylene)	35
Toluene	300
1,1,1-trichloroethane (methyl chloroform)	1000
Trichloroethene (trichloroethylene)	600
Xylene isomers	700
Total volatile organic compounds (TVOC)	—[b]

a. This test is only required if carpets and fabrics with styrene butadiene rubber (SBR) latex backing material are installed as part of the base building systems.

b. TVOC reporting shall be in accordance with CDPH/EHLB/Standard Method V1.1 and shall be in conjunction with the individual VOCs listed.

flush-out with *outdoor air*, and retest the specific parameters exceeded to demon- strate that the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomply- ing building areas, take samples from the same locations as in the first test.

1001.3.1.6 (10.3.1.6) Moisture Control. The following items to control moisture shall be implemented during construction:

a. Materials stored on-site, or materials installed that are absorptive, shall be protected from mois- ture damage.

b. Building construction materials that show visual evidence of biological growth due to the presence of moisture shall not be installed on the *building project*.

1001.3.1.7 (10.3.1.7) Construction Activity Pollution Prevention: Idling of Construction Vehicles. Con- struction-related vehicles shall not idle on the construc- tion *site* for more than five minutes in any 60-minute period, except where necessary to perform their con- struction-related function. Signage shall be posted at vehicle entrances to the *building project* providing notice of this requirement.

1001.3.1.8 (10.3.1.8) Construction Activity Pollution Prevention: Protection of Occupied Areas. The *con- struction documents* shall identify operable windows, doors, and air intake openings that serve occupied *spaces*, including those not associated with the *building project*, that are in the area of construction activity or within 35 ft (11 m) of the limits of construction activ- ity. Such windows, doors, and air intake openings that are under control of the *owner* shall be closed, or other measures shall be taken to limit *contaminant* entry.

Management of the affected buildings not under the control of the *building project owner* shall be notified in writing of planned construction activity and possible entry of *contaminants* into their buildings.

1001.3.1.9 (10.3.1.9) Soil-Gas Control. The building shall be tested, postconstruction, for radon in accor- dance with ANSI/AARST MALB. The indoor radon concentration shall be below 2.7 pCi/L (100 Bq/m^3). Where radon testing indicates that the indoor radon concentration is 2.7 pCi/L (100 Bq/m^3) or greater, radon mitigation shall be conducted in accordance with ANSI/AARST RMS-LB, and the building shall be retested to verify that the radon concentration is below 2.7 pCi/L (100 Bq/m^3).

1001.3.1.10 (10.3.1.10) Construction Waste Manage- ment.

1001.3.1.10.1 (10.3.1.10.1) Collection. Specific areas on the construction *site* shall be designated for collection of recyclable and reusable materials. Alternatively, off-site storage and sorting of materi- als shall be permitted. Diversion efforts shall be tracked throughout the construction process.

1001.3.1.10.2 (10.3.1.10.2) Documentation. Prior to issuance of the final certificate of occupancy, a final construction waste management report documenting compliance with Section 901.3.1 (9.3.1) shall be submitted to the *owner* and *AHJ*.

1001.3.2 (10.3.2) Plans for Operation. This section specifies the items to be included in plans for operation of a *building project* that falls under the requirements of this code.

1001.3.2.1 (10.3.2.1) High-Performance Building Operation Plan. A master building plan for operation shall be developed that meets the requirements specified in Sections 1001.3.2.1.1 (10.3.2.1.1) through 1001.3.2.1.5 (10.3.2.1.5).

1001.3.2.1.1 (10.3.2.1.1) Reserved1001.3.2.1.2 (10.3.2.1.2) Water Use Efficiency. The plan for operation shall specify water use *verifi- cation* activities for *building projects* to track and assess building water consumption. The plan shall describe the procedures needed to comply with the requirements outlined below.

1001.3.2.1.2.1 (10.3.2.1.2.1) Initial M&V. Use the water measurement devices and collection/ storage infrastructure specified in Section 601.3.3 (6.3.3) to collect and store water use data for each device, starting no later than after building acceptance testing has been completed and certificate of occupancy has been issued.

1001.3.2.1.1.2 (10.3.2.1.1.2) Track and Assess Water Use. The plan shall specify the procedures for tracking and assessing the *building project* water use and the frequency for benchmark com- parisons. The initial assessment shall be com- pleted after 12 months but no later than 18 months after a certificate of occupancy has been issued. Ongoing assessments shall be completed at least every three years. The plan shall include the fol- lowing:

a. **Water use reports.** Develop a plan for col- lecting *building project* water use data for water sources and subsystems measured in Section 601.3.3 (6.3.3).

b. **Benchmark water performance.** Develop a plan to enter building operating character- istics and water use data into the ENERGY STAR Portfolio Manager. For building parameter inputs into Portfolio Manager (***Informative Note:*** e.g., number of occu- pants, hours of operation, etc.), use actual average values.

c. **Assess water use performance.** Develop a plan to assess *building project* water use efficiency.

1001.3.2.1.2.3 (10.3.2.1.2.3) Documentation of Water Use. All documents associated with the M&V of the building's water use shall be retained by the *owner* for a minimum of three years.

1001.3.2.1.3 (10.3.2.1.3) Energy Efficiency. The plan for operation shall specify energy performance *verification* activities for *building projects* to track and assess building energy performance. The plan shall describe the procedures needed to comply with the requirements outlined in the following subsec- tions.

1001.3.2.1.3.1 (10.3.2.1.3.1) Initial M&V. Use the energy measurement devices and collection/ storage infrastructure specified in Section 701.3.3 (7.3.3) to collect and store energy data for each device, starting no later than after acceptance testing has been completed and certificate of occupancy has been issued.

1001.3.2.1.3.2 (10.3.2.1.3.2) Track and Assess Energy Consumption. The plan for operation shall specify the procedures for tracking and assessing the *building project* energy performance and the

frequency for benchmark comparisons. The initial assessment shall be completed after 12 months but no later than 18 months after a certifi- cate of occupancy has been issued. Ongoing assessments shall be completed at least every three years. The plan shall include the following:

a. **Energy use reports.** Develop a plan for collecting *building project* energy data for energy sources and system energy loads measured in Section 701.3.3 (7.3.3). The

reports shall include the following, as a minimum:

1. Hourly load profile for each day;
2. Monthly average daily load profile;
3. Monthly and annual energy use; and
4. Monthly and annual peak demand.

b. **Track energy performance.** Develop a plan to enter building operating characteristics and energy consumption data into the ENERGY STAR Portfolio Manager for those building types addressed by this program to track building performance. For building parameter inputs into Portfolio Manager (***Informative Note:*** e.g., number of occupants, hours of operation, number of PCs, etc.), use actual average values.

c. **Assess energy performance.** Develop a plan to assess *building project* energy per- formance.

1001.3.2.1.3.3 (10.3.2.1.3.3) Documentation of Energy Efficiency. All documents associated with the M&V of the building's energy efficiency shall be retained by *owner*.

1001.3.2.1.4 (10.3.2.1.4) For buildings located in nonattainments areas for ozone, as defined by the USEPA, air cleaning equipment, as defined in Section 801.3.1.3(b) [8.3.1.3(b)], shall be operated continu- ously during occupied hours during the

local summer and fall seasons or when the USEPA Air Quality Index exceeds 100 or equivalent designations by the local authorities for ozone.

Exception: *Spaces* without mechani- cal ventilation.

1001.3.2.2 (10.3.2.2) Maintenance Plan. A *maintenance plan* shall be developed for mechanical, electrical, plumbing, and fire protection systems. The plan shall include the following:

a. The plan shall be in accordance with ANSI/ASHRAE/ACCA Standard 180 for HVAC systems in buildings that meet the definition of commercial buildings in ASHRAE/ACCA Standard 180.

b. The plan shall address all elements of ASHRAE/ACCA Standard 180, Section 4, and shall develop required inspection and maintenance tasks similar to ASHRAE/ACCA Standard 180, Section 5, for electrical and plumbing systems in buildings that meet the definition of commercial buildings in ASHRAE/ACCA Standard 180.

c. *Outdoor air* delivery monitors required by Section 801.3.1.2 (8.3.1.2) shall be visually inspected at least once each quarter and cleaned or repaired, as necessary, and calibrated at the manufacturer's recommended interval or not less than once per year, whichever is more frequent.

d. For systems with a damper indicator and with less than 2000 cfm (1000 L/s) of supply air, the system components that control the *minimum outdoor airflow* shall be visually inspected every two years. Records of this inspection shall be maintained on-site either in electronic or written form.

e. Documentation of the plan and of completed maintenance procedures shall be maintained on the building *site* at all times in:

1. electronic format for storage on the building energy management system (EMS), building management system (BMS), computerized maintenance management system (CMMS), or other computer storage means, or

2. maintenance manuals specifically devel- oped and maintained for documenting com- pleted maintenance activities.

1001.3.2.3 (10.3.2.3) Reserved

1001.3.2.4 (10.3.2.4) Transportation Management Plan. A transportation management plan shall be devel- oped compliant with the following requirements. *Owner* shall retain a copy of the transportation manage- ment plan.

1001.3.2.4.1 (10.3.2.4.1) All Building Projects. The plan shall include the following:

a. Preferred parking for carpools and vanpools with parking facilities.

b. A plan for bicycle transportation.

TABLE 1001.3.2.3 (TABLE 10.3.2.3) MINIMUM DESIGN SERVICE LIFE FOR BUILDINGS

CATEGORY	MINIMUM SERVICE LIFE	BUILDING TYPES
Temporary	Up to 10 years	Nonpermanent construction buildings (sales offices, bunkhouses) Temporary exhibition buildings
Medium life	25 years	Industrial buildings Stand-alone parking structures
Long life	50 years	All buildings not temporary or medium life, including the parking structures below buildings designed for long life category

CONSTRUCTION AND PLANS FOR OPERATION

1001.3.2.4.2 (10.3.2.4.2) Owner-Occupied Build- ing Projects or Portions of Building Projects. For *owner*-occupied buildings, or for the employees in the *owner*-occupied portions of a building, the build- ing *owner* shall offer at least one of the following primary benefits to the *owner*'s employees:

a. Incentivize employees to commute using mass transit, vanpool, carpool, or nonmotorized forms of transportation.

b. Initiate a telework or flexible work schedule program that reduces by at least 5% the num- ber of commuting trips by the *owner*'s employees.

c. Initiate a ridesharing or carpool matching pro- gram, either in-house or through an outside organization.

Exception: Multifamily *residential build- ing project.*

In addition, the *owner* shall provide all of the fol- lowing to the *owner*'s employees:

a. Access to an *emergency ride home* for employees, either provided in-house or by an outside organization.
b. A central point of contact in charge of com- muter benefits.
c. Maintenance of commuter benefits in a cen- tralized location.
d. Active promotion of commuter benefits to employees.

1001.3.2.4.3 (10.3.2.4.3) Building Tenant. The building *owner*

a. shall provide a copy of the plan to tenants within the building; and
b. shall not include parking fees in lease rates, or shall identify the value of parking in the lease.

CHAPTER 11
NORMATIVE REFERENCES

Section numbers indicate where the reference occurs in this document.

AARST

American Association of Radon Scientists and Technologists 475 South Church Street, Suite 600 Hendersonville, NC 28792

ANSI/AARST RMS-LB-2014: Radon Mitigation Standards for Schools and Large Buildings
1001.3.1.9 (10.3.1.9), 1001.3.2.1.4.4 (10.3.2.1.4.4)

ANSI/AARST MALB-2014: Protocols for Measuring Radon and Radon Decay Products in School and Large Buildings
1001.3.1.9 (10.3.1.9), 1001.3.2.1.4.4 (10.3.2.1.4.4)

AHAM

Association of Home Appliance Manufacturers
1111 19th Street NW, Suite 402
Washington, DC, 20036

ANSI/AHAM RAC-1-R2015: Room Air Conditioners
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AHRI

Air-Conditioning, Heating, and Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

ANSI/AHRI 210/240-2008 (with Addenda 1 and 2): Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
Appendix B

ANSI/AHRI 310/380-2014: Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-14)
Appendix B

AHRI 340/360-2015 (I-P): Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
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ANSI/AHRI 365-2009: Performance Rating of Commercial and Industrial Unitary Air-Conditioning Condensing Units
Appendix B

ANSI/AHRI 460-2005: Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
Appendix B

ANSI/AHRI 1230-2010 (with Addendum 2): Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment
Appendix B

AMCA

Air Movement and Control Association International, Inc. 30 West University Drive Arlington Heights, IL 60004-1893

ANSI/AMCA 220-05 (R2012): Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating
701.4.2.4 (7.4.2.4)

ANSI

American National Standards Institute
25 West 43rd Street
New York, NY 20036

ANSI Z21.10.3-2015: Gas Water Heaters, Volume 3, Storage Water Heaters with Input Ratings above 75,000 Btu/h, Circulating and Instantaneous
Appendix B

ANSI Z21.11.2-2013: Gas-fired room heaters, volume II, unvented room heaters
801.3.1.5 (8.3.1.5)

ANSI Z21.47-2012: Gas-Fired Central Furnaces
Appendix B

ANSI Z83.4-2015/CSA 3.7-2015: Non-recirculating direct gas-fired industrial air heaters
801.3.1.5 (8.3.1.5)

ANSI Z83.8-2013: Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces
Appendix B

ANSI Z83.19-2009/CSA 2.35-2009: Gas-fired high-intensity infrared heaters
801.3.1.5 (8.3.1.5)

ASA

Acoustical Society of America
1305 Walt Whitman Road
Suite 300
Melville, NY 11747-4300

ANSI/ASA S1.13-2005 (R2010): Measurement of Sound Pressure Levels in Air
1001.3.1.1.2 (10.3.1.1.2)

ANSI/ASA S1.4-2014: Sound Level Meters
1001.3.1.1.2 (10.3.1.1.2)

ANSI/ASA S12.60-2009: Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 2: Relocatable Classroom Factors
801.3.3 (8.3.3), 801.3.3.4 (8.3.3.4)

ANSI/ASA S12.60-2010: Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools
801.3.3 (8.3.3)

ANSI/ASA 12.72-2015: Measuring the Ambient Noise Level in a Room
1001.3.1.1.2 (10.3.1.1.2)

ASABE

American Society of Agricultural and Biological Engineers
2950 Niles Road
Saint Joseph, MI 49085

ASABE/ICC 802-2014: Landscape Irrigation Sprinkler and Emitter Standard
601.3.1.2.1 (6.3.1.2.1)

ASHE

American Society for Healthcare Engineering of the American Hospital Association 155 N. Wacker Drive, Suite 400
Chicago, IL 60606

2014 FGI Guidelines: Hospitals and Outpatient Facilities: Guidelines for Design and Construction of Hospitals and Outpatient Facilities

801.3.3 (8.3.3)

2014 FGI Guidelines: Residential Health, Care and Support Facilities: Guidelines for Design and Construction of Residential Health, Care, and Support Facilities

801.3.3 (8.3.3)

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta, GA 30329

ANSI/ASHRAE Standard 52.2-2017: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
801.3.1.3 (8.3.1.3)

ANSI/ASHRAE Standard 55-2017: Thermal Environmental Conditions for Human Occupancy
801.3.2 (8.3.2), 1001.3.2.1.5 (10.3.2.1.5)

ANSI/ASHRAE Standard 62.1-2016: Ventilation for Acceptable Indoor Air Quality
301.2 (3.2), 701.4.3.2 (7.4.3.2), 701.4.3.8 (7.4.3.8), 801.3 (8.3), 1001.3.1.5 (10.3.1.5), 1001.3.2.1.4 (10.3.2.1.4)

ANSI/ASHRAE Standard 62.2-2016: Ventilation and Acceptable Indoor Air Quality in Residential Buildings
801.3.1 (8.3.1), 801.3.1.1 (8.3.1.1), 801.3.1.5 (8.3.1.5)

ANSI/ASHRAE/IES Standard 90.1-2016: Energy Standard for Buildings Except Low-Rise Residential Buildings
301.1 (3.1), 301.2 (3.2), 501.3.6 (5.3.6), 701.3.1 (7.3.1), 701.4.1 (7.4.1), 701.4.2 (7.4.2), 701.4.3 (7.4.3), 701.4.4 (7.4.4), 701.4.5 (7.4.5), 701.4.6 (7.4.6), 701.4.7 (7.4.7), 701.4.8 (7.4.8), 801.3.1.10 (8.3.1.10), 1001.3.1.3.5 (10.3.1.3.5), Appendix A, Appendix B, Appendix C

ANSI/ASHRAE Standard 111-2008: Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems
801.3.1.2.2 (8.3.1.2.2), 1001.3.2.1.4 (10.3.2.1.4), 1001.3.2.1.4.6 (10.3.2.1.4.6)

ANSI/ASHRAE Standard 146-2011: Method of Testing and Rating Pool Heaters
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ANSI/ASHRAE Standard 154-2011: Ventilation for Commercial Cooking Operations
701.4.3.8.1 (7.4.3.8.1)

ANSI/ASHRAE Standard 160-2016: Criteria for Moisture-Control Design Analysis in Buildings
801.3.6 (8.3.6)

ANSI/ASHRAE Standard 169-2013: Climatic Data for Building Design Standards
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ANSI/ASHRAE/ASHE Standard 170-2013: Ventilation of Health Care Facilities
801.3.1 (8.3.1)

ANSI/ASHRAE/ACCA Standard 180-2012: Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems
301.2 (3.2), 1001.3.2.2 (10.3.2.2)

ANSI/ASHRAE/IES Standard 202-2013: Commissioning Process for Buildings and Systems
1001.3.1.2 (10.3.1.2), 1001.3.1.3 (10.3.1.3)

ASME

American Society of Mechanical
Engineers
Three Park Avenue
New York, NY 10016-5990

ASME A112.18.1-2012/CSA B125.1-12: Plumbing Supply Fittings
601.3.2.1 (6.3.2.1)

ASME A112.19.2-2013/CSA B45.1-13: Ceramic Plumbing Fixtures
601.3.2.1 (6.3.2.1)

ASME A112.19.14-2013: Six-Liter Water Closets Equipped with a Dual Flushing Device
601.3.2.1 (6.3.2.1)

ASME A112.19.19-2006: Vitreous China Nonwater Urinals
601.3.2.1 (6.3.2.1)

ASTM

ASTM
Internation
al 100
Barr
Harbor Dr.
West Conshohocken, PA 19428-2959

ASTM C33: Standard Specification for Concrete Aggregates
801.3.4.1.2
(8.3.4.1.2)

ASTM C518-15: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
Appendix A

ASTM C919-12: Standard Practice for Use of Sealants in Acoustical Applications.
801.3.3.1.1 (8.3.3.1.1), 801.3.3.2.3.3 (8.3.3.2.3.3), 801.3.3.3.2 (8.3.3.3.2)

ASTM C920-14: Standard Specification for Elastomeric Joint Sealants
801.3.4.1.1 (8.3.4.1.1)

ASTM C1371-15: Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
501.3.5.4 (5.3.5.4)

ASTM C1549-09(2014): Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
501.3.5.4 (5.3.5.4)

ASTM D1003-13: Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics
301.2 (3.2), 801.4 (8.4), 801.4.1.1.3 (8.4.1.1.3), 801.4.1.3 (8.4.1.3)

ASTM D1785-15: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
801.3.4.1.3 (8.3.4.1.3)

ASTM D5197-09e1: Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)
801.4.2 (8.4.2), 1001.3.1.5 (10.3.1.5)

ASTM E90-09: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
801.3.3.1.1 (8.3.3.1.1)

ASTM E336-14: Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings
801.3.3.1.1 (8.3.3.1.1), 1001.3.1.1.5.1.2 (10.3.1.1.5.1.2)

ASTM E408-13: Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
501.3.5.4 (5.3.5.4)

ASTM E492-09s: Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine
801.3.3.1.1 (8.3.3.1.1)

ASTM E779-10: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
1001.3.1.3.5 (10.3.1.3.5)

ASTM E972-96 (2013): Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight
301.2 (3.2)

ASTM E1007-14: Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission through Floor- Ceiling Assemblies and Associated Support Structures
801.3.3.1.1 (8.3.3.1.1)

ASTM E1643-11: Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
801.3.4.1.1 (8.3.4.1.1)

ASTM E1745-11: Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
801.3.4.1.1 (8.3.4.1.1)

ASTM E1827-11: Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door

1001.3.1.3.5 (10.3.1.3.5)

ASTM E1903-11: Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process
301.2 (3.2)

ASTM—continued

ASTM E1918-06(2015): Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
501.3.5.4 (5.3.5.4)

ASTM E1980-11: Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
501.3.5.4 (5.3.5.4)

ASTM E2399-11: Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems
501.3.5.5 (5.3.5.5)

ASTM E2843-17: Standard Specification for Demonstrating that a Building is in Walkable Proximity to Neighborhood Assets
501.3.1.1 (5.3.1.1)

ASTM E2844-15e1: Standard Specification for Demonstrating That a Building's Location Provides Access to Public Transit
501.3.1.1 (5.3.1.1)

ASTM E2921-16: Standard Practice for Minimum Criteria for Comparing Whole Building Life Cycle Assessments for Use with Building Codes and Rating Systems
901.5.1 (9.5.1)

BIFMA

Business and Institutional Furniture Manufacturer's Association 678 Front Avenue NW, Suite 150 Grand Rapids, MI 49504-5368

ANSI/BIFMA e3-2014: Furniture Sustainability Standard
801.4.2.5 (8.4.2.5), 901.4.1.4.3 (9.4.1.4.3)

ANSI/BIFMA M7.1-2011 (R2016): Standard Test Method For Determining VOC Emissions From Office Furniture Systems, Components and Seating
801.4.2.5 (8.4.2.5), 801.5.2 (8.5.2)

ANSI/BIFMA X7.1-2011 (R2016): Standard for Formaldehyde and TVOC Emissions of Low-Emitting Office Furniture Systems and Seating
801.4.2.5 (8.4.2.5)

CARB

California Air Resources Board 1001 "I" Street P.O. Box 2815 Sacramento, CA 95812

CARB SCM for Architectural Coatings-2007: California Air Resources Board (ARB) Suggested Control Measure for Architectural Coatings
801.4.2.2.2 (8.4.2.2.2)

No-Added Formaldehyde Based Resins: Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products. California Code of Regulations, Title 17, Sections 93120-93120.12
801.4.2.4 (8.4.2.4)

CDPH

California Department of Public Health Indoor Air Quality Section 850 Marina Bay Parkway Richmond, CA 94804

CDPH/EHLB/Standard Method V1.1 (2010): Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers—Version 1.1
801.4.2 (8.4.2), 801.5.2 (8.5.2), Table 1001.3.1.5 (Table 10.3.1.5), Appendix D

CE
N

European Committee for
Standardization
Avenue Marnix
17—B-1000
Brussels, Belgium

EN14500:2008: Blinds and shutters—Thermal and visual comfort—Test and calculation methods
801.3.8 (8.3.8)

CGSB

Canadian General Standards Board
Place du Portage III, 6B1
11
Laurier Street Gatineau,
Quebec K1A 1G6, Canada

CAN/CGSB 149.10-M86: Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method
1001.3.1.3.5 (10.3.1.3.5)

CAN/CGSB 149.15-96: Determination of the Overall Envelope Airtightness of Buildings by the Fan Pressurization Method Using the Building's Air Handling Systems
1001.3.1.3.5 (10.3.1.3.5)

CITES

Convention on International Trade in Endangered Species of Wild Fauna and Flora International
Environment House 11
Chemin des Anémones
CH-1219 Châtelaine, Geneva, Switzerland

CITES- 1973, amended 1979 and 1983: Convention on International Trade in Endangered Species of Wild Fauna and Flora
901.3.2 (9.3.2)

CRRC

Cooling Roof Rating Council
449 15th Street, Suite 400
Oakland, CA 94612

ANSI/CRRC S100-2016: Standard Test Methods for Determining Radiative Properties of Materials
501.3.5.4 (5.3.5.4)

CTI

Cooling Technology Institute
PO Box 681807
Houston, TX 77268

CTI ATC-105 (00): Acceptance Test Code for Water Cooling Towers
Appendix B

CTI ATC-105S (11): Acceptance Test Code for Closed-Circuit Cooling Towers
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CTI ATC-106 (11): Acceptance Test Code for Mechanical Draft Evaporative Vapor Condensers
Appendix B

CTI STD-201RS (15): Standard for the Certification of Water Cooling Tower Thermal Performance
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Green-e

Green-e
c/o Center for Resource Solutions
1012 Torney Ave.,
Second Floor
San Francisco,
CA 94129

Version 2.8, April 1, 2016: Green-e Energy National Standard for Renewable Electricity Products
701.4.1.1.1 (7.4.1.1.1)

GS

Green Seal
1001 Connecticut Avenue, NW, Suite 827
Washington, DC 20036-5525

GS-11, 3.2, October 26, 2016: Green Seal Standard for Paints, Coatings, Stains, and Sealers. Section 3.0: "Product-Specific

Health and Environmental Requirements"
801.4.2.2.2 (8.4.2.2.2)

GS-36, 2.1, July 12, 2013: Standard for Adhesives for Commercial Use
801.4.2.1.2 (8.4.2.1.2)

GS-42, July 7, 2015: Standard for Commercial and Institutional Cleaning Services
1001.3.2.1.4.5 (10.3.2.1.4.5)

IA

Irrigation Association
8280 Willow Oaks Corporate Drive, Suite 400
Fairfax, VA 22031

Smart Water Application Technologies (SWAT) Climatologically Based Controllers, 8th Testing Protocol—September 2008: Smart Water Application Technologies (SWAT), Turf and Landscape Irrigation System Smart Controllers, Climatologically Based Controllers
301.2 (3.2), 601.3.1.2.2 (6.3.1.2.2)

IAPMO

International Association of Plumbing and Mechanical
Officials 5001
East Philadelphia
Street
Ontario, CA 91761

Z124.9-2004: Plastic Urinal Fixtures
601.3.2.1 (6.3.2.1)

ICC

International Code
Council
500 New Jersey Ave NW # 300
Washington, DC 20001

2018 IBC: International Building Code®
102.4, 102.6, 104.1

2018 IECC: International Energy Conservation Code®
102.4

2018 IEBC: International Existing Building Code®
102.4, 102.6

2018 IFC: International Fire Code®
102.4, 102.6, 501.3.5.5 (5.3.5.5)

2018 IFGC: International Fuel Gas Code®
102.4

2018 IMC: International Mechanical Code®
102.4

2018 IPC: International Plumbing Code®
102.4, 601.3.5.3 (6.3.5.3)

2018 IPMC: International Property Maintenance Code®
102.4, 102.6

2018 IRC: International Residential Code®
101.3.2 (2.2), 102.4

2018 ICC PC: Performance Code for Buildings and Facilities®
102.4

IES

Illuminating Engineering Society
120 Wall Street, Floor 17
New York, NY 10005-4001

TM-15-2011 including addendum a: Luminaire Classification System for Outdoor Luminaires
501.3.6.2 (5.3.6.2)

LM-83-12: Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)
301.2 (3.2), 801.5.1 (8.5.1)

ISO

International Organization for Standardization
ISO Central Secretariat, 1 rue de Varembee, Case postale 56
CH-1211 Geneva 20, Switzerland

ISO-9972-2015: Thermal Performance of Buildings—Determination of Air Permeability of Buildings—Fan Pressurization Method
1001.3.1.3.5 (10.3.1.3.5)

ISO-13256-1-1998: Water-Source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-Air and Brine-to-Air Heat Pumps
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ISO-13256-2-1998: Water-Source Heat Pumps—Testing and Rating for Performance—Part 2: Water-to-Water and Brine-to-Water Heat Pumps
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ISO 14025-2006: Environmental Labels and Declarations—Type III Environmental Declarations—Principles and Procedures
901.4.1.4 (9.4.1.4)

ISO 14040-2006: Environmental Management—Life Cycle Assessment—Principles and Framework
901.4.1.4 (9.4.1.4)

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901.5.1 (9.5.1), 901.5.1.2 (9.5.1.2)

ISO 21930-2007: Sustainability in Building Construction—Environmental Declaration of Building Products
901.4.1.4 (9.4.1.4)

ISO/IEC-17025-2005 (Reviewed 2010): General Requirements for the Competence of Testing and Calibration Laboratories
801.4.2 (8.4.2)

ISO/IEC 17065-2012: Conformity Assessment—Requirements for Bodies Certifying Products, Processes, and Services
801.4.2 (8.4.2)

ISO/IEC Guide 59-1994: Code of Good Practice for Standardization
901.4.1.3.1 (9.4.1.3.1)

NEMA

National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

ANSI/NEMA MG 1-2009: Motors and Generators
701.4.3.1 (7.4.3.1)

NEMA DC 3, Annex A-2013: Energy-Efficiency Requirements for Programmable Thermostats
701.4.7.4 (7.4.7.4)

NFPA

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

NFPA 70-2014: National Electrical Code
501.3.6.3 (5.3.6.3)

NFRC

National Fenestration Rating
Council
6305 Ivy Lane, Suite 140
Greenbelt, MD 20770-6323

ANSI/NFRC 200-2014: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence
301.2 (3.2)

NSC

Natural Stone Council
P.O. Box 539
Hollis, NH 03049

NSC 373-2013: Sustainable Production of Natural Dimension Stone
901.4.1.4 (9.4.1.4)

NSF

NSF International
789 Dixboro Road
Ann Arbor, MI 48105

NSF/ANSI 44-2016: Residential Cation Exchange Water Softeners
601.3.5 (6.3.5)

NSF/ANSI 58-2016: Reverse Osmosis Drinking Water Treatment Systems
601.3.6 (6.3.6)

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901.4.1.4 (9.4.1.4)

NSF/ANSI 332-2015: Sustainability Assessment for Resilient Floor Coverings
901.4.1.4 (9.4.1.4)

NSF/ANSI 336-2011: Sustainability Assessment for Commercial Furnishings Fabric
901.4.1.4 (9.4.1.4)

NSF/ANSI 342-2014: Sustainability Assessment for Wallcovering Products
901.4.1.4 (9.4.1.4)

NSF/ANSI 347-2012: Sustainability Assessment for Single Ply Roofing Membranes
901.4.1.4 (9.4.1.4)

NSF/ANSI 350-2017: On-Site Residential and Commercial Water Reuse Systems
601.3.7 (6.3.7)

PHIUS

Passive House Institute US

116 West Illinois Street
Suite 5E
Chicago, IL 6065

PHIUS+ 2018 Passive Building Standard

SCAQMD

South Coast Air Quality Management District
California Air Resources Board
1001 "I" Street; P.O. Box 2815
Sacramento, CA 95812

SCAQMD Rule 1113r, Amended February 5, 2016: Architectural Coatings
801.4.2.2 (8.4.2.2)

SCAQMD Rule 1168, Amended January 7, 2005: Adhesive and Sealant Applications
801.4.2.1 (8.4.2.1)

TCNA

Tile Council of North America
100 Clemson Research Boulevard
Anderson, SC 29625

ANSI A138.1-2011: Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials
901.4.1.4 (9.4.1.4)

UL

Underwriters Laboratories
Inc.
333 Pfingsten Road
Northbrook, IL 60062

UL 100-2012: Standard for Sustainability for Gypsum Boards and Panels
901.4.1.4 (9.4.1.4)

UL 102-2012: Standard for Sustainability for Door Leafs
901.4.1.4 (9.4.1.4)

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UL 727-2006: Standard for Oil-Fired Central Furnaces
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UL 731-2012: Standard for Oil-Fired Unit Heaters
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U.S. Congress

United States Congress
Washington, DC 20515

EPAct 2005 HR6 Public Law 109-58: The Energy Policy Act (EPAct) of 2005
701.4.7.3 (7.4.7.3)

EISA 2007 HR6 Public Law 110-140: The Energy Independence and Security Act of 2007
701.4.7 (7.4.7)

USDA

United States Department of Agriculture
BioPreferred Program
1400 Independence Avenue, SW
Washington, DC 20250

7 CFR Part 3201 Subpart B, (Includes Rounds 1–7) August 29, 2011; Round 8, April 4, 2012; Round 9, November 19, 2012; Round 10, June 11, 2013: Guidelines for Designating Biobased Products for Federal Procurement; Designated Items
901.4.1.3 (9.4.1.3)

USDOE

United States Department of Energy
Energy Information Administration
Washington, DC 20585

10 CFR Part 430, App N: Uniform Test Method for Measuring the Energy Consumption of Furnaces
Appendix B

USEPA

United States Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Code of Federal Regulations, Title 40 Part 50 (40 CFR 50), as amended July 1, 2004: National Primary and Secondary Ambient Air Quality Standards
801.3.1.3 (8.3.1.3)

EPA 420-F-07-063, November 2007: Green Vehicle Guide: Consider a SmartWay Vehicle Program—Requirements for Certified Passenger Vehicles
501.3.7 (5.3.7)

EPA 625/R-96/0106, January 1999: Compendium of Methods for the Determination of Toxic Organic Pollutants in Ambient Air, Sections TO-1, TO-11, TO-17
1001.3.1.5 (10.3.1.5)

February 16, 2012: NPDES General Permit for Stormwater Discharges From Construction Activities
1001.3.1.4 (10.3.1.4)

USEPA Method TO-17 (1999): Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes
801.4.2 (8.4.2)

Version 1.0, August 1, 2012: ENERGY STAR Program Requirements for Uninterruptible Power Supplies
701.4.7 (7.4.7)

Version 1.0, August 14, 2009: WaterSense Specification for Flushing Urinals
601.3.2.1 (6.3.2.1)

Version 1.0, March 4, 2010: WaterSense Specification for Showerheads
601.3.2.1 (6.3.2.1)

Version 1.0, October 1, 2007: WaterSense Tank-Type High-Efficiency Lavatory Faucet Specification
601.3.2.1 (6.3.2.1)

USEPA—continued

Version 1.0, November 3, 2011: WaterSense Specification for Weather-Based Irrigation Controllers
601.3.1.2 (6.3.1.2)

Version 1.2, August 1, 2003: ENERGY STAR Program Requirements for Commercial Steam Cookers
701.4.7 (7.4.7)

Version 1.2, July 1, 2004: ENERGY STAR Program Requirements for Room Air Cleaners
701.4.7 (7.4.7)

Version 1.2, June 2, 2014: WaterSense Tank-Type High-Efficiency Toilet Specification
601.3.2.1 (6.3.2.1)

Version 1.2, May 8, 2009: ENERGY STAR Program Requirements for Commercial Griddles
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WTO

World Trade Organization
Centre William Rappard
Rue de
Lausanne 154, CH-
1211 Geneva 21,
Switzerland

WTO TBT-1994: WTO Technical Barriers to Trade (TBT) Agreement Annex 3 Code of Good Practice for the Preparation, Adoption and Application of Standards
901.4.1.3.1 (9.4.1.3.1)