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 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 residential 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 environmental 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

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Mandatory</th>
<th>Project Electives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 4</td>
<td>401.3</td>
<td>NA</td>
</tr>
</tbody>
</table>
101.4.2 (4.1.1) 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. 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. Informative 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 reasons of convenience are placed apart from all other normative 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 contained in another standard. The reference standard reproduction annexes are not part of this code but are included in its publication to facilitate its use.
SCOPE AND ADMINISTRATION

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.


102.4.1 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. 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 jurisdiction shall have the authority to approve programs or compliance 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 (Informativ 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 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 (CO₂ₑ): a measure used to compare the impact of various greenhouse gases based on their global warming potential (GWP). CO₂ₑ approximates the time-integrated warming effect of a unit mass of a given greenhouse gas relative to that of carbon dioxide (CO₂). 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 CO₂. The following GWP values are used based on a 100-year time horizon: 1 for CO₂, 25 for methane (CH₄), and 298 for nitrous oxide (N₂O).

classroom: a space primarily used for scheduled instructional activities.

climate zone: see Normative Appendix A.

combined energy efficiency ratio (CEER [I-P]) (CCOPc [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.

cycle 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 ft² (100 m²).

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: evapotranspiration of the plant material derived by multiplying ET₀ by the appropriate plant factor or coefficient.

ET₀: 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.

gerformance 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.

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** ($L_{A_{eq}}$): 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 **hardscapes** 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 AHI.
- **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 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** ($L_{A_{max}}$): 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.

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, document 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 compatible plants: plants with documented ET 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.

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), 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).
**DEFINITIONS, ABBREVIATIONS AND ACRONYMS**

**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 recovered material in a product or packaging. Only preconsumer and postconsumer materials shall be considered as recycled content. (See recovered 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 salvaged 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 \(\text{Vertical fenestration VT}\) is the visible transmittance of vertical fenestration as determined in accordance with NFRC 200. For products outside the scope of NFRC 200, \(\text{VT}\) 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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>µg</td>
<td>microgram</td>
</tr>
<tr>
<td>AC</td>
<td>alternating current</td>
</tr>
<tr>
<td>AHJ</td>
<td>authority having jurisdiction</td>
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<tr>
<td>AHRI</td>
<td>Air-Conditioning, Heating, and Refrigeration Institute</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ASE</td>
<td>annual sunlight exposure</td>
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<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
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<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials International</td>
</tr>
<tr>
<td>BIFMA</td>
<td>The Business and Institutional Furniture Manufacturer’s Association</td>
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<tr>
<td>BMS</td>
<td>building management system</td>
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<tr>
<td>BoD</td>
<td>Basis of Design</td>
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<td>BPF</td>
<td>building performance factor</td>
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<tr>
<td>Btu</td>
<td>British thermal unit</td>
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<tr>
<td>Btu/h</td>
<td>British thermal unit per hour</td>
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<tr>
<td>BUG</td>
<td>backlight, upright, and glare</td>
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<tr>
<td>CAC</td>
<td>ceiling attenuation class</td>
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<tr>
<td>CCOP</td>
<td>combined coefficient of performance</td>
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<tr>
<td>CDPH</td>
<td>California Department of Public Health</td>
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<tr>
<td>CEER</td>
<td>combined energy efficiency ratio</td>
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<tr>
<td>CFC</td>
<td>Chlorofluorocarbon</td>
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<tr>
<td>cfm</td>
<td>cubic feet per minute (ft³/min)</td>
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<tr>
<td>CH₄</td>
<td>methane</td>
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<tr>
<td>c.i.</td>
<td>continuous insulation</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>CIE</td>
<td>Commission Internationale de L’Eclairage (International Commission on Illumination)</td>
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<tr>
<td>CITES</td>
<td>Convention on International Trade in Endangered Species of Wild Fauna and Flora</td>
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<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
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<tr>
<td>CO₂e</td>
<td>carbon dioxide equivalent</td>
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<td>CSA</td>
<td>Canadian Standards Association</td>
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<tr>
<td>cSTC</td>
<td>composite sound transmission class</td>
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<tr>
<td>Cx</td>
<td>commissioning</td>
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<td>dB</td>
<td>decibel</td>
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<tr>
<td>db</td>
<td>dry bulb</td>
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<tr>
<td>dBA</td>
<td>decibel, A-weighting</td>
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<tr>
<td>dBC</td>
<td>decibel, C-weighting</td>
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<tr>
<td>DC</td>
<td>direct current</td>
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<td>DCV</td>
<td>demand control ventilation</td>
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<td>DR</td>
<td>demand response</td>
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<tr>
<td>EISA</td>
<td>Energy Independence and Security Act</td>
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<tr>
<td>EMS</td>
<td>Energy Management System</td>
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<tr>
<td>EPAct</td>
<td>U.S. Energy Policy Act</td>
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<td>EPD</td>
<td>environmental product declaration</td>
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<tr>
<td>ESC</td>
<td>erosion and sedimentation control</td>
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<tr>
<td>ETₜₑ</td>
<td>evapotranspiration</td>
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<tr>
<td>ETₜₒ</td>
<td>maximum evapotranspiration</td>
</tr>
<tr>
<td>ETS</td>
<td>environmental tobacco smoke</td>
</tr>
<tr>
<td>fc</td>
<td>footcandle</td>
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<tr>
<td>FF&amp;E</td>
<td>furniture, fixtures, and equipment</td>
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<tr>
<td>FPT</td>
<td>functional and performance testing</td>
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<tr>
<td>ft</td>
<td>foot</td>
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<tr>
<td>gal</td>
<td>gallon</td>
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<tr>
<td>gpm</td>
<td>gallons per minute</td>
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<tr>
<td>GWP</td>
<td>global warming potential</td>
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<td>h</td>
<td>hour</td>
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<tr>
<td>ha</td>
<td>hectare</td>
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<tr>
<td>HCFC</td>
<td>hydrochlorofluorocarbon</td>
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<tr>
<td>HID</td>
<td>high-intensity discharge</td>
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<tr>
<td>HVAC</td>
<td>heating, ventilation, and air conditioning</td>
</tr>
<tr>
<td>HVAC&amp;R</td>
<td>heating, ventilation, air conditioning, and refrigeration</td>
</tr>
<tr>
<td>Hz</td>
<td>hertz</td>
</tr>
<tr>
<td>IA</td>
<td>Irrigation Association</td>
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<tr>
<td>IAPMO</td>
<td>International Association of Plumbing and Mechanical Officials</td>
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<tr>
<td>IAQ</td>
<td>indoor air quality</td>
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<tr>
<td>IECC</td>
<td>International Energy Conservation Code</td>
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<tr>
<td>IEQ</td>
<td>indoor environmental quality</td>
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<tr>
<td>IES</td>
<td>Illuminating Engineering Society</td>
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<tr>
<td>IIC</td>
<td>impact insulation class</td>
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<tr>
<td>in.</td>
<td>inch</td>
</tr>
<tr>
<td>I-P</td>
<td>inch-pound</td>
</tr>
<tr>
<td>ISR</td>
<td>impact sound rating</td>
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<tr>
<td>kg</td>
<td>kilogram</td>
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<tr>
<td>km</td>
<td>kilometre</td>
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<tr>
<td>kVA</td>
<td>kilovolt-ampere</td>
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<tr>
<td>kW</td>
<td>kilowatt</td>
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<tr>
<td>kWh</td>
<td>kilowatt-hour</td>
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<tr>
<td>L</td>
<td>litre</td>
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<tr>
<td>lb</td>
<td>pound</td>
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<tr>
<td>LCA</td>
<td>life-cycle assessment</td>
</tr>
<tr>
<td>LCI</td>
<td>life-cycle inventory</td>
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<tr>
<td>Lₚ₉₀</td>
<td>hourly average sound pressure level</td>
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<tr>
<td>Lₘₐₓ</td>
<td>maximum sound pressure level</td>
</tr>
<tr>
<td>LPD</td>
<td>lighting power density</td>
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<tr>
<td>Ls</td>
<td>liner system</td>
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<td>LZ</td>
<td>lighting zone</td>
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<tr>
<td>m</td>
<td>metre</td>
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<tr>
<td>MDF</td>
<td>medium density fiberboard</td>
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<tr>
<td>MERV</td>
<td>minimum efficiency reporting value</td>
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<tr>
<td>mg</td>
<td>milligram</td>
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<tr>
<td>mi</td>
<td>mile</td>
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<tr>
<td>min</td>
<td>minute</td>
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<tr>
<td>mm</td>
<td>millimetre</td>
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<tr>
<td>mph</td>
<td>miles per hour</td>
</tr>
<tr>
<td>M&amp;V</td>
<td>measurement and verification</td>
</tr>
<tr>
<td>N₂O</td>
<td>nitrous oxide</td>
</tr>
<tr>
<td>NA</td>
<td>not applicable</td>
</tr>
<tr>
<td>NAECa</td>
<td>National Appliance Energy Conservation Act</td>
</tr>
<tr>
<td>NIC</td>
<td>noise isolation class</td>
</tr>
<tr>
<td>NISR</td>
<td>normalized impact sound rating</td>
</tr>
<tr>
<td>NNIC</td>
<td>normalized noise isolation class</td>
</tr>
<tr>
<td>NPLV</td>
<td>nonstandard part-load value</td>
</tr>
<tr>
<td>NR</td>
<td>not required</td>
</tr>
<tr>
<td>OITC</td>
<td>outdoor-indoor transmission class</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>operations and maintenance</td>
</tr>
<tr>
<td>OPR</td>
<td>owner’s project requirements</td>
</tr>
<tr>
<td>Pa</td>
<td>Pascal</td>
</tr>
<tr>
<td>PCI</td>
<td>Performance Cost Index</td>
</tr>
<tr>
<td>PF</td>
<td>projection factor</td>
</tr>
<tr>
<td>ppm</td>
<td>parts per million</td>
</tr>
<tr>
<td>RCR</td>
<td>room cavity ratio</td>
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</tbody>
</table>
### Definitions, Abbreviations and Acronyms

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

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.

401.6 (4.6.) Passive House Approach. New residential buildings shall comply with 401.6.1 through 401.6.3.


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 following:

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 preservation.

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 landfill. Invasive plants shall not be planted on the building project site.
501.3.2 (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% of 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 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 2-4 in. 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.

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 demon-
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, clearing, or filling of the site.

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 systems 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 contract 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·ft² (100 L/min·m²).

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:

- 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.
- 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:
- Roof penetrations and associated equipment.
- On-site renewable energy systems, including photovoltaics, solar thermal energy collectors, and required access around the panels or collectors.
- Portions of the roof used to capture heat for building energy technologies.
- Roof decks and rooftop walkways.
- 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 CO₂e, as calculated in accordance with Section 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·ft²·°F (11.9 W/m²·°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.

501.3.6 (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 instrumentation 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 features.

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 requirements 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 instrumentation 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 features.

### 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**

<table>
<thead>
<tr>
<th>DISTANCE IN MOUNTING HEIGHTS TO NEAREST PROPERTY LINE</th>
<th>LZ0</th>
<th>LZ1</th>
<th>LZ2</th>
<th>LZ3</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 1 and &lt; 2</td>
<td>G0</td>
<td>G0</td>
<td>G1</td>
<td>G1</td>
</tr>
<tr>
<td>≥ 0.5 and &lt; 1</td>
<td>G0</td>
<td>G0</td>
<td>G0</td>
<td>G1</td>
</tr>
<tr>
<td>&lt; 0.5</td>
<td>G0</td>
<td>G0</td>
<td>G0</td>
<td>G0</td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>DISTANCE IN MOUNTING HEIGHTS TO NEAREST PROPERTY LINE</th>
<th>LZ0</th>
<th>LZ1</th>
<th>LZ2</th>
<th>LZ3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowed Backlight Rating</td>
<td>B1</td>
<td>B3</td>
<td>B4</td>
<td>B5</td>
</tr>
<tr>
<td>&gt; 2 mounting heights from property line</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 2 mounting heights from property line</td>
<td>B1</td>
<td>B3</td>
<td>B4</td>
<td>B5</td>
</tr>
<tr>
<td>0.5 to 1 mounting height to property line</td>
<td>B0</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
</tr>
<tr>
<td>&lt; 0.5 mounting height to property line</td>
<td>B0</td>
<td>B0</td>
<td>B0</td>
<td>B1</td>
</tr>
<tr>
<td>Allowed Uplight Rating – Luminaires ≥3,500 lumens</td>
<td>U0</td>
<td>U0</td>
<td>U0</td>
<td>U0</td>
</tr>
<tr>
<td>Allowed Uplight Rating – Luminaires &lt;3,500 lumens</td>
<td>U0</td>
<td>U0</td>
<td>U1</td>
<td>U2</td>
</tr>
<tr>
<td>Allowed Glare Rating</td>
<td>G0</td>
<td>G1</td>
<td>G2</td>
<td>G3</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th></th>
<th>LZ0</th>
<th>LZ1</th>
<th>LZ2</th>
<th>LZ3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total fixture lumens per</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>square foot of facade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>used for facade lighting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>that is allowed to be</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>emitted above 90 degrees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>or higher from nadir</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(straight down)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2018 INTERNATIONAL GREEN CONSTRUCTION CODE®
501.3.7 (5.3.7) Mitigation of Transportation Impacts.

501.3.7.1 (5.3.7.1) Pedestrian and Bicycle Connectivity.

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 delineated.

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
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 bicycle parking space shall be provided with a securely mounted rack or other facilities for locking or securing 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 parking that is not visible from the building entrance.

501.3.7.2.6 (5.3.7.2.6) Documentation. Construction documents shall include plans and details showing 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.
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 limited 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 Section 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 calculations 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, recycling, 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 alternate 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 irrigate 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 calculation of the improved landscape for schools, residential 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 temporarily 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, for turf grass and 55% of ET, 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 landscape 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 irrigation 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

<table>
<thead>
<tr>
<th>Plumbing Fixture</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water closets (toilets)—flushometer single-flush valve type</td>
<td>Single-flush volume of <strong>1.1</strong> gal</td>
</tr>
<tr>
<td>Water closets (toilets)—flushometer dual-flush valve type</td>
<td>Full-flush volume of <strong>1.1</strong> gal</td>
</tr>
<tr>
<td>Water closets (toilets)—single-flush tank-type</td>
<td>Single-flush volume of <strong>1.1</strong> gal</td>
</tr>
<tr>
<td>Water closets (toilets)—dual-flush tank-type</td>
<td>Full-flush volume of <strong>1.1</strong> gal</td>
</tr>
<tr>
<td>Urinals</td>
<td>Flush volume <strong>0.125</strong> gal</td>
</tr>
<tr>
<td>Public lavatory faucets</td>
<td>Flow rate—<strong>0.5</strong> gpm (1.9 L/min)</td>
</tr>
<tr>
<td>Public metering self-closing faucet</td>
<td>0.25 gal (1.0 L) per metering cycle</td>
</tr>
<tr>
<td>Residential bathroom lavatory sink faucets</td>
<td>Flow rate—<strong>1.2</strong> gpm</td>
</tr>
<tr>
<td>Residential kitchen faucets</td>
<td>Flow rate—<strong>1.8</strong> gpm (6.8 L/min) *</td>
</tr>
<tr>
<td>Residential showerheads</td>
<td>Flow rate—<strong>1.8</strong> gpm</td>
</tr>
<tr>
<td>Residential shower compartment (stall) in dwelling units and guest rooms</td>
<td>Flow rate from all shower outlets total of <strong>1.8</strong> gpm</td>
</tr>
</tbody>
</table>

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#### 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.

#### 601.3.2.2 (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 settings 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 systems 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 provisions 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 determined in accordance with ASME A112.19.2/CSA B45.1, shall not exceed 0.125 gal. Flushing urinals shall comply with the performance criteria of the USEPA WaterSense Specification 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 WaterSense High-Efficiency Lavatory Faucet Specification.

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 Showerheads.

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 compartment exceeds 2600 in.² (1.7 m²), an additional flow of 1.8 gpm shall be permitted for each multiple of 2600 in.² (1.7 m²) of floor area or fraction thereof.

j. **Water-bottle filling stations.** Water-bottle filling 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 premises.

### 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 Requirements for Dishwashers. Maximum water use shall be as follows:

1. **Clothes washers**—Maximum water factor (WF) of 5.4 gal/ft³ 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 maximum 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 requirements 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-operated clothes washers of any size used in laundromats, shall have a maximum WF of 4.0 gal/ft³ of drum capacity normal cycle (0.53 L/L of drum capacity normal cycle). [See also the energy efficiency 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 prohibited.
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/L (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 Operations. Commercial food service operations (Informative 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 Facilities. 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 vacuum 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 applicant 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) equipment 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. Measurement devices with remote communication capability 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 project 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 ft² (5000 m²), 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 any building totaling in excess of 50,000 ft² (5000 m²), 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 provide 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 at 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 submeter 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

DRAFT ONLY
NOT FOR REPRODUCTION
TABLE 601.3.4.1A (TABLE 6.3.4.1A)
WATER SUPPLY SOURCE MEASUREMENT THRESHOLDS

<table>
<thead>
<tr>
<th>WATER SOURCE</th>
<th>MAIN MEASUREMENT THRESHOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potable water</td>
<td>1000 gal/day (3800 L/day)</td>
</tr>
<tr>
<td>Municipally reclaimed water</td>
<td>1000 gal/day (3800 L/day)</td>
</tr>
<tr>
<td>Alternate sources of water</td>
<td>500 gal/day (1900 L/day)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SUBSYSTEM</th>
<th>SUBMETERING THRESHOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling towers (meter on makeup water and blowdown)</td>
<td>Cooling tower flow through tower &gt; 500 gpm (30 L/s)</td>
</tr>
<tr>
<td>Evaporative coolers</td>
<td>Makeup water &gt; 0.6 gpm (0.04 L/s)</td>
</tr>
<tr>
<td>Steam and hot-water boilers</td>
<td>&gt; 500,000 Btu/hr (150 kW) input</td>
</tr>
<tr>
<td>Total irrigated landscape area with controllers</td>
<td>&gt; 25,000 ft² (2500 m²)</td>
</tr>
<tr>
<td>Separate campus or project buildings</td>
<td>Consumption &gt; 1000 gal/day (3800 L/day)</td>
</tr>
<tr>
<td>Separately leased or rental space</td>
<td>Consumption &gt; 1000 gal/day (3800 L/day)</td>
</tr>
<tr>
<td>Any large water-using process</td>
<td>Consumption &gt; 1000 gal/day (3800 L/day)</td>
</tr>
<tr>
<td>Tenant Spaces</td>
<td>Consumption &gt; 10% of the total annual consumption of that space</td>
</tr>
</tbody>
</table>

601.3.5 (6.3.6) Reverse Osmosis Water Treatment Systems. 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 drinking 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 urinals 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 closets 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/ft² (20 kWh/m²) for single-story buildings and not less than 7.0 kBtu/ft² (32 kWh/m²) 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/ft²·day (4.0 kWh/m²·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. Measurement devices with remote communication capability 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 sensors 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 communicated to the data acquisition system.

**TABLE 701.3.3.1A (TABLE 7.3.3.1A) ENERGY SOURCE THRESHOLDS**

<table>
<thead>
<tr>
<th>ENERGY SOURCE</th>
<th>THRESHOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical service</td>
<td>&gt; 200 kVA</td>
</tr>
<tr>
<td>On-site renewable electric power</td>
<td>All systems &gt; 1 kVA (peak)</td>
</tr>
<tr>
<td>Gas and district services</td>
<td>&gt; 1,000,000 Btu/h (300 kW)</td>
</tr>
<tr>
<td>Geothermal energy</td>
<td>&gt; 1,000,000 Btu/h (300 kW)</td>
</tr>
<tr>
<td>On-site renewable thermal energy</td>
<td>&gt; 100,000 Btu/h (30 kW)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>USE (TOTAL OF ALL LOADS)</th>
<th>SUBSYSTEM THRESHOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC system</td>
<td>Connected electric load &gt; 100kVA</td>
</tr>
<tr>
<td></td>
<td>Connected gas or district services load &gt; 500,000 Btu/h (150 kW)</td>
</tr>
</tbody>
</table>

**701.3.3.2 (7.3.3.2) Energy Consumption Data Collection and Display.** All building measurement devices shall be configured to automatically communicate the energy data to the data acquisition system. Measurement devices shall provide daily data and shall record hourly energy profiles. Such hourly energy profiles shall be capable of being used to assess building performance 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 electronically 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 residential.

**701.3.4 (7.3.4) Demand Response.** Building projects shall contain control systems that have
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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 implementing load adjustments to the HVAC and lighting systems.

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 be 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 adjustment 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 specified 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 baseline 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 lighting 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 institutional 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).

701.4.1.1 (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/ft² (20 kWh/m²) multiplied by the horizontal projection of the gross roof area in feet squared (metres squared) for single-story buildings, and not less than 7.0 kBtu/ft² (32 kWh/m²) 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 compliance with both of the following are not required to contain on-site renewable energy systems:

1. 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 4.0 kWh/m²·day (1.2 kBTU/ft²·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/ft² (75 kWh/m²) of conditioned space each year until the cumulative purchase totals 70
kWh/ft² (750 kWh/m²) 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 Appendix 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·ft²·°F (6.81 W/m²·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.
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(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

<table>
<thead>
<tr>
<th>SHGC MULTIPLIER</th>
<th>(ALL OTHER ORIENTATIONS)</th>
<th>(NORTH-ORIENTED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.80</td>
<td></td>
<td>0.95</td>
</tr>
</tbody>
</table>

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 fenestration 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. \[ A_W \times SHGC_W \leq (A_N \times SHGCC_c + A_S \times SHGCC_e)/6 \] and \[ A_E \times SHGC_E \leq (A_N \times SHGCC_c + A_S \times SHGCC_e)/6 \]

where:

\[ SHGC_c = \] the SHGC criteria for each climate zone from Section 701.4.2.1 (7.4.2.1).
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\[ A_x = \text{fenestration area for orientation} \times \]

\[ N = \text{north (oriented less than 45 degrees of true north).} \]

\[ S = \text{south (oriented less than 45 degrees of true south).} \]

\[ E = \text{east (oriented less than or equal to 45 degrees of true east).} \]

\[ W = \text{west (oriented less than or equal to 45 degrees of true west).} \]

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).

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

\[ 701.4.3.1 (7.4.3.1) \text{ Minimum Equipment Efficiencies}. \] All building projects shall comply with the applicable equipment efficiency requirements in Normative Appendix B and the applicable 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 Section 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:


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.”


e. Table 6.8.1-14, “Vapor Compression Based Indoor Pool Dehumidifiers—Minimum Efficiency 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.”

\[ 701.4.3.1.1 (7.4.3.1.1) \text{ Water-Cooled Centrifugal Chiller Packages Efficiency Adjustment}. \]

a. For Water-Cooled Centrifugal Units Rated per AHRI Standard 550/590 (I-P). Equipment 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:

\[ \text{FL}_{adj} = \text{FL}/K_{adj} \]

\[ \text{PLV}_{adj} = \text{IPLV}/K_{adj} \]

\[ K_{adj} = A \times \]
where:

\[ B = FL \times PLV_{adj} \]

- **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.
ENERGY EFFICIENCY

\[
A = 0.000000145920 \times (LIFT)^4 - 0.0000346496 \times (LIFT)^3 + 0.00314196 \times (LIFT)^2 - 0.147199 \times LIFT + 3.93073.
\]

\[
B = 0.0015 \times LvgEvap + 0.934.
\]

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:

\[
FL_{adj} = FL \times K_{adj}
\]
\[
PLV_{adj} = IPLV \times K_{adj}
\]

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

\[
PLV_{adj} = \text{minimum NPLV rating, adjusted for nonstandard conditions.}
\]

\[
A = 0.00000153181 \times (LIFT)^4 - 0.000202076 \times (LIFT)^3 + 0.0101800 \times (LIFT)^2 - 0.264958 \times LIFT + 3.93073.
\]

\[
B = 0.0027 \times LvgEvap + 0.982.
\]

Lift = LvgCond – LvgEvap.
LvgCond = full-load condenser leaving fluid spaces.

4. Spaces with one of the following occupancy categories as listed in ANSI/ASHRAE Standard 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 compliance 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 CO₂ sensors used as part of a DCV system or any other system that dynamically controls outdoor air shall meet the following requirements:

a. Spaces with CO₂ sensors or air-sampling probes leading to a central CO₂ monitoring station shall be provided with at least one sensor or probe for each 10,000 ft² (1000 m²) of floor space. Sensors or probes shall be installed between 3 and 6 ft (1 and 2 m) above the floor.

b. CO₂ sensors shall have a rated accuracy of ±50 ppm at 1000 ppm.
c. Outdoor air CO₂ concentrations shall be determined by one of the following:

1. Outdoor air CO₂ concentrations shall be dynamically measured using one or multiple CO₂ sensors. The CO₂ sensor locations shall be identified on the construction documents.

2. When documented statistical data on the local ambient CO₂ 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 CO₂ 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 condenser-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 Limitation. Systems shall have fan power limitations 10% below the limitations specified in the IECC, Table C403.8.1(1). This requirement supersedes the requirement in the IECC, Section C403.8, and the IECC, Table C403.8.1(2). All exceptions in the IECC, Section C403.8, shall apply.

701.4.3.6.2 (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.

701.4.3.6.3 (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>
<thead>
<tr>
<th>TABLE 701.4.3.4 (TABLE 7.4.3.4)</th>
<th>MINIMUM SYSTEM SIZE FOR WHICH AN ECONOMIZER IS REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIMATE ZONES</td>
<td>COOLING CAPACITY FOR WHICH AN ECONOMIZER IS REQUIRED*a</td>
</tr>
<tr>
<td>5B</td>
<td>33,000 Btu/h (9.7 kW)a</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>FAN LOCATION</th>
<th>MINIMUM EFFICACY (CFM/WATT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRV or ERV</td>
<td>1.2 cfm/watt</td>
</tr>
<tr>
<td>In-line fan</td>
<td>3.8 cfm/watt</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>6.0 cfm/watt</td>
</tr>
</tbody>
</table>
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 ventilation 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 products 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 demonstrated 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>
<thead>
<tr>
<th>TYPE OF HOOD</th>
<th>LIGHT-DUTY EQUIPMENT</th>
<th>MEDIUM-DUTY EQUIPMENT</th>
<th>HEAVY-DUTY EQUIPMENT</th>
<th>EXTRA-HEAVY-DUTY EQUIPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cfm per linear foot</td>
<td>L/s per linear metre</td>
<td>cfm per linear foot</td>
<td>L/s per linear metre</td>
</tr>
<tr>
<td>Wall-mounted canopy</td>
<td>140</td>
<td>217</td>
<td>210</td>
<td>325</td>
</tr>
<tr>
<td>Single island a</td>
<td>280</td>
<td>433</td>
<td>350</td>
<td>541</td>
</tr>
<tr>
<td>Double island (per side)</td>
<td>175</td>
<td>271</td>
<td>210</td>
<td>325</td>
</tr>
<tr>
<td>Eyebrow</td>
<td>175</td>
<td>271</td>
<td>175</td>
<td>271</td>
</tr>
<tr>
<td>Backshelf/Passover</td>
<td>210</td>
<td>325</td>
<td>210</td>
<td>325</td>
</tr>
</tbody>
</table>

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 Control.** 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 automatically 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 occupied for up to 16 hours.

b. A *networked guest-room control system* indicates the guest room is unrented and the guest room is unoccupied for no more than 30 minutes.

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 permitted 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 automatically 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 preoccupation 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.** Captive 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 projects* shall comply 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 minimum 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 supersede 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 supersede 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/ft² (8.6 W/m²) 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/ft² (1 W/m²). 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 Lighting. All exterior sign lighting, including internally illuminated 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 regulation.
2. Signs in tunnels.


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 parking 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

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**TABLE 701.4.6.2 (TABLE 7.4.6.2) LIGHTING POWER ALLOWANCE FACTORS**

<table>
<thead>
<tr>
<th>Controlled Zone for a Period No Longer Than 15</th>
<th>LZ0</th>
<th>LZ1</th>
<th>LZ2</th>
<th>LZ3</th>
<th>LZ4</th>
</tr>
</thead>
<tbody>
<tr>
<td>For tradable areas, uncovered parking areas: parking areas and drives with measured SRI &lt; 29 or without SRI measurement</td>
<td>Not allowed</td>
<td>1</td>
<td>0.75</td>
<td>0.83</td>
<td>0.63</td>
</tr>
<tr>
<td>For tradable areas, uncovered parking areas: parking areas and drives with new concrete without added color pigment or with measured SRI ≥ 29</td>
<td>Not allowed</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>For tradable areas, other</td>
<td>1.00</td>
<td>0.90</td>
<td>0.90</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>For nontradable areas</td>
<td>1.00</td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
</tr>
</tbody>
</table>
minutes. No more than 1500 input watts of lighting 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 structures 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 projects shall comply with the applicable equipment efficiency requirements 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 ft² (2500 m²) 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.

b. Heating and Cooling:
   1. Programmable thermostats: ENERGY STAR Program Requirements for Programmable Thermostats.

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:
   2. Copiers: ENERGY STAR Program Requirements for Imaging Equipment.
   3. Fax machines: ENERGY STAR Program Requirements for Imaging Equipment.
   5. Mailing machines: ENERGY STAR Program Requirements for Imaging Equipment.


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

f. Commercial Food Service:
   2. Commercial hot food holding cabinets: ENERGY STAR Program Requirements 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)].
   6. Commercial ovens: ENERGY STAR Program Requirements for Commercial 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 Appliance 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 Appendix 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 Program Requirements for Clothes Washers
ENERGY EFFICIENCY

[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)].


5. Dehumidifiers: ENERGY STAR Program Requirements for Dehumidifiers.

6. Residential warm air furnaces: ENERGY STAR Program Requirements for Furnaces.


2. Commercial ice machines: ENERGY STAR Program Requirements for Commercial Refrigerators and Freezers.

f. Other Products:

1. Battery charging systems: ENERGY STAR Program Requirements for Products with Battery Charger Systems (BCSs).


3. Vending machines: ENERGY STAR Program Requirements for Refrigerated Beverage Vending Machines.

701.4.7.4 (7.4.7.4) Programmable Thermostats. Residential 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 superseded 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, Section 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, Section C401.2, option 1(c)(2), the Source Energy Index Target (SEI) shall be calculated in accordance with the following:

\[
\text{SEI} = 0.77 \times \frac{\text{BBUSE} + \text{BPF} \times \text{BBRSE}}{\text{BBP}}
\]

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.

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...
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 filter.

801.3.1.4 (8.3.1.4) Building Pressure. The requirements 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 dampers whenever mechanical intake airflow is discontinued.

   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 requirements 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 801.3.1.6.2 Direct Evaporative Cooling. 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.
**INDOOR ENVIRONMENTAL QUALITY (IEQ)**

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 verify 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 noncompliance with the required acoustical performance. The construction documents and any reports shall show all the pertinent data and features of the building, equipment, and systems in sufficient detail to permit a determination of compliance by the authority having jurisdiction (AHJ) and to indicate compliance with the requirements of this code.

801.3.4 (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 routinely 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 materials shall meet or exceed the durability requirements of ASTM E1745, and the installation 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 bearing 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 compensate 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 surrounded 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, geotextile 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 Section 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) (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-permeable 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.
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) 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 perforated 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 Conveyance 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

<table>
<thead>
<tr>
<th>SYSTEM VENT PIPE NOMINAL DIAMETER</th>
<th>MINIMUM DIAMETER OF PITS *</th>
<th>MINIMUM LENGTH OF PERFORATED PIPE OR GEOTEXTILE MATTING *</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 in. (0.08 m)</td>
<td>12 in. (0.30 m) diameter pit</td>
<td>18 ft (5.4 m)</td>
</tr>
<tr>
<td>4 in. (0.10 m)</td>
<td>16 in. (0.40) diameter pit</td>
<td>32 ft (10 m)</td>
</tr>
<tr>
<td>6 in. (0.15 m)</td>
<td>24 in. (0.60 m) diameter pit</td>
<td>71 ft (22 m)</td>
</tr>
</tbody>
</table>

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 cm²/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 cm²/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 otherwise 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 footings 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 vertical 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 (8.3.4.1). Exception: Where inspections verify compliance 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

<table>
<thead>
<tr>
<th>VENT PIPE DIAMETER</th>
<th>MAXIMUM VENTED AREA PER VENT PIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 in. (0.08 m)</td>
<td>2500 ft² (230 m²)</td>
</tr>
<tr>
<td>4 in. (0.10 m)</td>
<td>4500 ft² (420 m²)</td>
</tr>
<tr>
<td>6 in. (0.15 m)</td>
<td>10,000 ft² (1000 m²)</td>
</tr>
</tbody>
</table>

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 ft² (23.3 m²) 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, 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 transmission 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 interior partitions as described in Section 801.3.6.2 (8.3.6.2). Conditions conducive to condensate formation, as demonstrated 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 constructed 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 temperature for the coldest three months of the year (winter condition). The analysis shall include all building envelope 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 occupancy 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 envelope 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 mechanical systems that are designed to
control condensation 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 Penetrations 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 ft² (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.
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 requirements:

a. The combined area of the skylights within the space shall not be less than 3% of the calculated daylight area under skylights.

b. The space shall have a skylight effective aperture 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 transmittance 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 Section 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 ft² (23 m²) 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 fenestration is provided by buildings, structures, geological formations, or permanent exterior projections that are not horizontal, as determined 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 controlled shading devices in compliance with Exception (2) of Section 701.4.2.5 (7.4.2.5).

5. Vertical fenestration with automatically controlled 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.

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### TABLE 801.4.1.2A (TABLE 8.4.1.2A) DAYLIT SPACES

<table>
<thead>
<tr>
<th>Classroom/training room</th>
<th>Conference/meeting/multipurpose room except in convention centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lounge/breakroom</td>
<td>Enclosed office and open plan office</td>
</tr>
<tr>
<td>Library reading area</td>
<td>Patient rooms and physical therapy rooms within a healthcare facility</td>
</tr>
</tbody>
</table>

---

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

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>MINIMUM SIDELIGHTING EFFECTIVE APERTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0, 1, 2, 3A, 3B</td>
<td>0.10</td>
</tr>
<tr>
<td>3C, 4, 5, 6, 7, 8</td>
<td>0.15</td>
</tr>
</tbody>
</table>
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 following 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), specialty primers, stains, stone consolidants, swimming-pool coatings, tub- and tile-refining coatings, undercoaters, 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 system and applied on-site) shall comply with either Section 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/Standard Method V1.1, 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 Requirements.

a. The VOC content for flat and nonflat coatings, nonflat high-gloss coatings, specialty coatings, 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, conjugated oil varnish, lacquer, and clear brushing lacquer shall be determined and limited in accordance with Green Seal Standard GS-11.

b. The VOC content for concrete curing compounds, dry fog coatings, faux finishing coatings, graphic arts coatings (sign paints), industrial maintenance coatings, mastic texture coatings, metallic pigmented coatings, multicolor coatings, pretreatment wash primers, reactive penetrating sealers, recycled coatings, specialty primers, wood preservatives, and zinc primers shall be determined and limited 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 coatings, stone consolidants, swimming-pool coatings, 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

<table>
<thead>
<tr>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic and concrete tile</td>
</tr>
<tr>
<td>Natural stone</td>
</tr>
<tr>
<td>Gypsum plaster</td>
</tr>
<tr>
<td>Clay masonry</td>
</tr>
<tr>
<td>Concrete masonry</td>
</tr>
<tr>
<td>Concrete</td>
</tr>
<tr>
<td>Metal</td>
</tr>
</tbody>
</table>

801.4.2.4 (8.4.2.4) Composite Wood, Wood Structural 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 adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain 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 (commonly referred to as California Section 01350) and shall comply with the limit requirements for either office or classroom spaces, regardless of the space type.

**Exceptions:** Structural panel components such as plywood, particle board, wafer board, and oriented strand board identified as “EXPOSURE 1,” “EXTERIOR,” or “HUD-APPROVED” are considered 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. Calculations 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, gymnasium, 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 daytime 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, calculated 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 ft² (23 m²).
2. Vertical fenestration with automatically controlled shading devices in compliance with Section 701.4.2.5 (7.4.2.5), Exception (2).
3. Vertical fenestration with automatically controlled 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 concentration 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 materials 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, linoleum tile, wood floor strips, parquet flooring, laminated flooring, and modular carpet tile.

b. Sheet and roll goods, including broadloom carpet, 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 control 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 illuminance, 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 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.

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 destination 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 percentages 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) 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 (9.3.2.1) 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 (9.3.2.2) Reserved

901.3.2.3 (9.3.2.3) Reserved

901.3.2.4 (9.3.2.4) Reserved

901.3.2.5 (9.3.2.5) Mercury Content Levels of Lamps. Electric lamps used in the building project
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.
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 resistant, cold temperature, and three-way lamps.
9. LED lamps
MATERIALS AND RESOURCES

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: Sections 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 recycled 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 (Informative Note: e.g., the cementitious materials, aggregates, and water) shall be permitted to be treated as separate components and calculated separately.

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 products. 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 Components. 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 documentation 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 building components from a vendor shall be permitted to
TABLE 901.3.5 (TABLE 9.3.5)
MAXIMUM MERCURY CONTENT FOR ELECTRIC LAMPS

<table>
<thead>
<tr>
<th>LAMP</th>
<th>MAXIMUM MERCURY CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw-base compact fluorescent lamps &lt; 25 W</td>
<td>4 mg</td>
</tr>
<tr>
<td>Screw-base compact fluorescent lamps ≥ 25 W and &lt; 40 W</td>
<td>5 mg</td>
</tr>
<tr>
<td>Pin-base compact fluorescent lamps, all wattages</td>
<td>5 mg</td>
</tr>
<tr>
<td>Straight fluorescent T5 normal lifetime lamps a</td>
<td>3 mg</td>
</tr>
<tr>
<td>Straight fluorescent T8 normal lifetime lamps a</td>
<td>4 mg</td>
</tr>
<tr>
<td>Straight fluorescent T5 and T8 long lifetime lamps b</td>
<td>5 mg</td>
</tr>
<tr>
<td>T12 eight-foot straight fluorescent lamps</td>
<td>15 mg</td>
</tr>
</tbody>
</table>

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.

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 product. Where the program operator explicitly recognizes 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 represents 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 compliance with Section 901.4.1.4 (9.4.1.4).
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 standard. 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

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).

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).

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:
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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 quantities 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 physical 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.
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 (10.3.1.1), 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 testing 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.

1001.3.1.1.2 (10.3.1.1.2) 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 systems shall be verified.

b. FPT of systems shall be verified.

Exception: Systems for which operation is seasonally dependent, and which cannot be fully commissioned in accordance with the commissioning (Cx) plan at the time of occupancy, shall be commissioned at the earliest operation time, postoccupancy, as determined by the FPT providers.

c. The preparation of operation and maintenance (O&M) documentation and warranty information shall be verified. O&M documentation, including the information needed to understand, operate, and maintain the building systems, shall be provided to the building owner and facility manager.

1001.3.1.1.3 (10.3.1.1.3) Documentation. The completed project design and FPT documentation shall be provided to the owner and shall be retained with the project records.

1001.3.1.2 (10.3.1.2) Acoustical Control.

1001.3.1.2.1 (10.3.1.2.1) Acoustical Field Measurement. Where required by
Chapter 8 (Section 8), the FPT specified in Sections 1001.3.1.2.1.1 (10.3.1.2.1.1) through 1001.3.1.2.1.2 (10.3.1.2.1.2) shall be completed.

**1001.3.1.2.1.1 (10.3.1.2.1.1) 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.

1001.3.1.2.1.2 (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.

1001.3.1.2.1.3 (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 maintenance staff.
1001.3.1.2.1 (10.3.1.2.1) Systems to be Commissioned. 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 building 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 passive) 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).

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 designated by the owner to manage Cx process activities prior to completion of construction documents. The Cx provider shall have the necessary training, experience, and equipment 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 Activities. 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 accordance 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 itemiza-
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 commissioned 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.
CONSTRUCTION AND PLANS FOR OPERATION

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 less than 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 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 ft² (1.5 L/s per m²) of outdoor air, or the outdoor airflow rate determined in Section 801.3.1.1 (8.3.1.1), 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.

\[
TAC = \frac{V}{H} \times \frac{1}{A} \times \frac{1}{60 \text{ min/h}} \times 24 \text{ h/day} \times 14 \text{ days (I-P)}
\]

\[
TAC = \frac{V}{H} \times \frac{1}{A} \times \frac{1}{3600 \text{ s/h}} \times 24 \text{ h/day} \times 14 \text{ days (SI)}
\]

(Equation 10-1)

where:

\[
TAC = \text{total air changes.}
\]
\[ V_{oa} = \text{system design outdoor air intake flow, cfm (L/s)} \]  
(according to ANSI/ASHRAE Standard 62.1).

\[ A = \text{floor area, ft}^2 (\text{m}^2). \]

\[ H = \text{ceiling height, ft (m)}. \]

2. **Postconstruction, preoccupancy baseline IAQ monitoring.** Baseline IAQ testing shall be conducted after construction ends and prior to occupancy. The ventilation 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 consistent 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 demonstrate that the contaminant maximum concentrations 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 serving the space intended for occupancy cannot 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 ft² (2500 m²) or (ii) in each contiguous floor area. For each sampling point where the maximum concentration limits are exceeded, conduct additional...
### TABLE 1001.3.1.5 (TABLE 10.3.1.5) MAXIMUM CONCENTRATION OF AIR POLLUTANTS RELEVANT TO IAQ

<table>
<thead>
<tr>
<th>CONTAMINANT</th>
<th>MAXIMUM CONCENTRATION, μg/m³ (UNLESS OTHERWISE NOTED)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nonvolatile Organic Compounds</strong></td>
<td></td>
</tr>
<tr>
<td>Carbon monoxide (CO)</td>
<td>9 ppm and no greater than 2 ppm above outdoor levels</td>
</tr>
<tr>
<td>Ozone</td>
<td>0.075 ppm (8-h)</td>
</tr>
<tr>
<td>Particulates (PM2.5)</td>
<td>35 (24 h)</td>
</tr>
<tr>
<td>Particulates (PM10)</td>
<td>150 (24 h)</td>
</tr>
<tr>
<td><strong>Volatile Organic Compounds</strong></td>
<td></td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>140</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>5</td>
</tr>
<tr>
<td>Benzene</td>
<td>60</td>
</tr>
<tr>
<td>1,3-buta diene</td>
<td>20</td>
</tr>
<tr>
<td>t-butyl methyl ether (methyl-t-butyl ether)</td>
<td>8000</td>
</tr>
<tr>
<td>Carbon disulfide</td>
<td>800</td>
</tr>
<tr>
<td>Caprolactam a</td>
<td>100</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>40</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>1000</td>
</tr>
<tr>
<td>Chloroform</td>
<td>300</td>
</tr>
<tr>
<td>1,4-dichlorobenzene</td>
<td>800</td>
</tr>
<tr>
<td>Dichloromethane (methylene chloride)</td>
<td>400</td>
</tr>
<tr>
<td>1,4-Dioxane</td>
<td>3000</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>2000</td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td>400</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>33</td>
</tr>
<tr>
<td>2-Ethylhexanoic acid a</td>
<td>25</td>
</tr>
<tr>
<td>n-Hexane</td>
<td>7000</td>
</tr>
<tr>
<td>1-methyl-2-pyrrolidinone a</td>
<td>160</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>9</td>
</tr>
<tr>
<td>Nonanal a</td>
<td>13</td>
</tr>
<tr>
<td>Octanal a</td>
<td>7.2</td>
</tr>
<tr>
<td>Phenol</td>
<td>200</td>
</tr>
<tr>
<td>4-phenylcyclohexene (4 PCH) a</td>
<td>2.5</td>
</tr>
<tr>
<td>2-propanol (isopropanol)</td>
<td>7000</td>
</tr>
<tr>
<td>Styrene</td>
<td>900</td>
</tr>
<tr>
<td>Tetrachloroethene (tetrachloroethylene, perchloroethylene)</td>
<td>35</td>
</tr>
<tr>
<td>Toluene</td>
<td>300</td>
</tr>
<tr>
<td>1,1,1-trichloroethane (methyl chloroform)</td>
<td>1000</td>
</tr>
<tr>
<td>Trichloroethene (trichloroethylene)</td>
<td>600</td>
</tr>
<tr>
<td>Xylene isomers</td>
<td>700</td>
</tr>
<tr>
<td><strong>Total volatile organic compounds (TVOC)</strong></td>
<td>—b</td>
</tr>
</tbody>
</table>

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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 demonstrate that the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying 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 moisture 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. Construction-related vehicles shall not idle on the construction site for more than five minutes in any 60-minute period, except where necessary to perform their construction-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 construction 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 activity. 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 accordance with ANSI/AARST MALB. The indoor radon concentration shall be below 2.7 pCi/L (100 Bq/m³). Where radon testing indicates that the indoor radon concentration is 2.7 pCi/L (100 Bq/m³) 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/m³).

1001.3.1.10 (10.3.1.10) Construction Waste Management.

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 materials 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) Reserved

1001.3.2.1.2 (10.3.2.1.2) Water Use Efficiency. The plan for operation shall specify water use verification 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.

1001.3.2.1.2.2 (10.3.2.1.2.2) 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 comparisons. The initial assessment shall be completed 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 following:

a. Water use reports. Develop a plan for collecting 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 characteristics and water use data into the ENERGY STAR Portfolio Manager. For building parameter inputs into Portfolio Manager (Informative Note: e.g., number of occupants, hours of operation, etc.), use actual average values.

c. Assess water use performance. Develop a plan to assess building project water use efficiency.

1001.3.2.1.3 (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 subsections.

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 certificate 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 performance.

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 continuously during occupied hours during the
CONSTRUCTION AND PLANS FOR OPERATION

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 mechanical 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 developed and maintained for documenting completed 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 developed compliant with the following requirements. Owner shall retain a copy of the transportation management 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.

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**TABLE 1001.3.2.3 (TABLE 10.3.2.3) MINIMUM DESIGN SERVICE LIFE FOR BUILDINGS**

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>MINIMUM SERVICE LIFE</th>
<th>BUILDING TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary</td>
<td>Up to 10 years</td>
<td>Nonpermanent construction buildings (sales offices, bunkhouses) Temporary exhibition buildings</td>
</tr>
<tr>
<td>Medium life</td>
<td>25 years</td>
<td>Industrial buildings Stand-alone parking structures</td>
</tr>
<tr>
<td>Long life</td>
<td>50 years</td>
<td>All buildings not temporary or medium life, including the parking structures below buildings designed for long life category</td>
</tr>
</tbody>
</table>
CONSTRUCTION AND PLANS FOR OPERATION

DRAFT ONLY
NOT FOR REPRODUCTION
1001.3.2.4.2 (10.3.2.4.2)  **Owner-Occupied Building Projects or Portions of Building Projects.**  For owner-occupied buildings, or for the employees in the owner-occupied portions of a building, the building 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 number of commuting trips by the owner’s employees.

c. Initiate a ridesharing or carpool matching program, either in-house or through an outside organization.

   **Exception:** Multifamily residential building project.
In addition, the *owner* shall provide all of the following 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 commuter benefits.

c. Maintenance of commuter benefits in a centralized 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 Appendix B

**AHRI**
Air-Conditioning, Heating, and Refrigeration Institute 2111 Wilson Blvd, Suite 500 Arlington, VA 22201

ANSI/AHRI 365-2009: Performance Rating of Commercial and Industrial Unitary Air-Conditioning Condensing Units 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)
NORMATIVE REFERENCES

ANSI
American National Standards Institute
25 West 43rd Street
New York, NY 10036

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
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ANSI Z21.47-2012: Gas-Fired Central Furnaces
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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
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ASA
Acoustical Society of America
1305 Walt Whitman Road
Suite 300
Melville, NY 11747-4300

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)
801.3.3 (8.3.3), 801.3.3.4 (8.3.3.4)
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

801.3.3 (8.3.3)


801.3.3 (8.3.3)
NORMATIVE REFERENCES

ASHRAE

1791 Tullie Circle NE
Atlanta, GA 30329

801.3.1.3 (8.3.1.3)

801.3.2 (8.3.2), 1001.3.2.1.5 (10.3.2.1.5)

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)

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), 801.3.10 (8.3.1.10), 1001.3.1.5.5 (10.3.1.5.5), Appendix A, Appendix B, Appendix C

801.3.1.2.2 (8.3.1.2.2), 1001.3.2.1.4 (10.3.2.1.4), 1001.3.2.1.6 (10.3.2.1.6)

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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)

301.2 (3.2), 1001.3.2.2 (10.3.2.2)

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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)
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ASTM

ASTM C33: Standard Specification for Concrete Aggregates
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ASTM C920-14: Standard Specification for Elastomeric Joint Sealants
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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)

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801.3.3.1.1 (8.3.3.1.1), 1001.3.1.5.1.2 (10.3.1.5.1.2)

501.3.5.4 (5.3.5.4)

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)

301.2 (3.2)

801.3.4.1.1 (8.3.4.1.1)

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)

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
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ASTM E2399-11: Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems
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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)
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)
801.4.2.5 (8.4.2.5), 801.5.2 (8.5.2)
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

801.4.2 (8.4.2.2), 801.5.2 (8.5.2), Table 1001.3.1.5 (Table 10.3.1.5), Appendix D
EN14500:2008: Blinds and shutters—Thermal and visual comfort—Test and calculation methods
801.3.8 (8.3.8)

2018 INTERNATIONAL GREEN CONSTRUCTION CODE®
### NORMATIVE REFERENCES

**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

901.3.2 (9.3.2)

**CRRC**

Cooling Roof Rating Council  
449 15th Street, Suite 400  
Oakland, CA 94612

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  
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CTI ATC-106 (11): Acceptance Test Code for Mechanical Draft Evaporative Vapor Condensers  
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CTI STD-201RS (15): Standard for the Certification of Water Cooling Tower Thermal Performance  
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**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)
### NORMATIVE REFERENCES

**IA**

In the United States:

- 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

  102.4, 102.6, 104.1
  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)
  102.4
- 2018 IMC: International Mechanical Code®
  102.4
- 2018 IPC: International Plumbing Code®
  102.4, 601.3.5.3 (6.3.5.3)
  102.4, 102.6
- 2018 IRC: International Residential Code®
  101.3.2 (2.2), 102.4
  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)
NORMATIVE REFERENCES

ISO
International Organization for Standardization
ISO Central Secretariat, 1 rue de Varembee, Case postale 56
CH-1211 Geneva 20, Switzerland

1001.3.1.3.5 (10.3.1.3.5)

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ISO 14025-2006: Environmental Labels and Declarations—Type III Environmental Declarations—Principles and Procedures
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901.4.1.4 (9.4.1.4)

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)

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)

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
I 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

301.2 (3.2)
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Natural Stone Council  
P.O. Box 539  
Hollis, NH 03049

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**NSF**

NSF International  
789 Dioxboro Road  
Ann Arbor, MI 48105

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**NSF/ANSI 58-2016:** Reverse Osmosis Drinking Water Treatment Systems  
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**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

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**TCNA**

Tile Council of North America  
100 Clemson Research Boulevard  
Anderson, SC 29625
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UL

Underwriters Laboratories
Inc.
333 Pfingsten Road
Northbrook, IL 60062

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USDA

United States Department of Agriculture
BioPreferred Program
1400 Independence Avenue, SW
Washington, DC 20250

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USDOE

United States Department of Energy
Energy Information Administration
Washington, DC 20585

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USEPA

United States Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460

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WTO

World Trade Organization
Centre William Rappard
Rue de
Lausanne 154, CH-
1211 Geneva 21,
Switzerland

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