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00_IgCC - ICC

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IgCC - ICC

Overview of the IgCC

The 2018 International Green Construction Code (IgCC) provides the design and construction industry with the single, most effective way to deliver sustainable, resilient, high-performance buildings. The 'IgCC-powered-by-189.1' joint initiative frames the essential sustainable construction building blocks on which future resilient initiatives can develop and expand.

By collaborating on developing the 2018 IgCC, the strategic developing organizations supporting it envision a new era of building design and construction that includes environmental health and safety as code minimums. The goal of the 2018 IgCC will provide fundamental criteria for energy efficiency, resource conservation, water safety, land use, site development, indoor environmental quality and building performance that can be adopted broadly.

Benefits of the IgCC:

- The International Green Construction Code provides a whole systems approach to the design, construction and operation of buildings.
- The International Green Construction Code includes measures that result in better indoor environments, lower impact on natural resources, better neighborhood connections, and improved walkability.
- The International Green Construction Code is coordinated with other model codes such as IECC®, 90.1, and many other referenced standards.
- The International Green Construction Code is a public/private collaboration that provides a green model code to government jurisdictions. As a result, government does not have to take on the high cost of developing its own code and benefits from the code uniformity among adopting jurisdictions.
- USGBC is developing synergies between specific IgCC measures and LEED® credits, enabling a streamlined approach to leadership that is built on a consistent green code.

Why IgCC?

- Green building strategies reinforce societal health/life/safety benefits that building codes offer, providing resilience to natural disasters, climate change, resource consumption/management, and service interruptions due to unforeseen events.
- Industry-leading codes, standards, and the LEED® rating system have enabled the construction sector to introduce fundamental strategies to protect occupant comfort and health, save money, and preserve resources during the design, construction, and operation of buildings.
- The implementation of green building design, construction, and operational techniques has increased. Many homeowners, businesses, and building

professionals have voluntarily sought to incorporate green building strategies into their projects, and a number of local and national systems have been developed to guide green building practices, including LEED®.

- Buildings account for over 12% of water use, 40% of CO2 emissions, 65% of all waste outputs, and more than 70% of electricity consumption. Our organizations believe green buildings offer solutions to many of these problems by conserving resources, regenerating sites, and providing economic and societal benefits.
- The benefits of green building design, construction, and operation should be enjoyed by residents, workers, and visitors of all cities.

On IgCC's Strategic Development Relationships with Key Industry Leaders – ICC, ASHRAE, USGBC, AIA and IES:

- Our organizations are dedicated to continuously improving the built environment by providing safe, sustainable and equitable buildings for all.
- Green codes help fulfill the mission of our organizations: To provide for the health, life and safety of the built environment; to increase economic and resource efficiency of buildings; to reduce effects of climate change through more resilient buildings, communities, and cities; and to provide for the best buildings of today without compromising the needs of future generations.
- Our goal is to transform the market by leveraging the strengths of ICC and ASHRAE to develop the highest standard of green building codes that provide direct connections to the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED®) rating system.
- The partnership between AIA, ASHRAE, ICC, IES and USGBC on the 2018 International Green Construction Code (IgCC®) represents the perfect formula for green building codes: The most trusted code development body; the most technically sophisticated HVAC&R standards development organization; the most influential green building rating system; and the design community's top-tier professional organizations.

- Our partnership represents model code developers, regulatory adoption agencies, building officials, architects, engineers, the design community, construction practitioners, sustainability professionals, and industry associations.

Code Development

Available Now: 2018 IgCC

- Purchase the 2018 IgCC, released in October 2018.

01_PREFACE | 2018 2018 International Green Construction Code® (IgCC®) | ICC premiumACCESS

SourceURL: https://codes.iccsafe.org/content/IGCC2018/preface

PREFACE

Introduction

Internationally, code officials and designers recognize the need for a modern, up-to-date code governing the impact of buildings and structures on the environment. This code is designed to meet this need through model code regulations that contain clear and specific requirements with provisions that promote safe and sustainable construction in an integrated fashion with the ICC Family of Codes. This 2018 International Green Construction Code® (IgCC®) is the first fully integrated edition of the IgCC to be developed cooperatively by ICC and ASHRAE.

This comprehensive green code establishes minimum regulations for building systems and site considerations using prescriptive and performance-related provisions. It is intended to be compatible with all of the International Codes® (I-Codes®) published by the International Code Council® (ICC®), including the International Building Code®, International Energy Conservation Code®, International Existing Building Code®, International Fire Code®, International Fuel Gas Code®, International Mechanical Code®, International Code Council Performance Code®, International Plumbing Code®, International Private Sewage Disposal Code®, International Property Maintenance Code®, International Residential Code®, International Swimming Pool and Spa Code®, International Wildland-Urban Interface Code® and International Zoning Code®.

This code has been developed in collaboration with the following Cooperating Sponsors: The American Institute of Architects (AIA); ASHRAE; the U.S. Green Building Council (USGBC); and the Illuminating Engineering Society (IES). ICC wishes to thank these Cooperating Sponsors for recognizing the need for the development of a comprehensive set of green regulations that are enforceable, usable and adoptable.

The I-Codes, including this International Green Construction Code, are used in a variety of ways in both the public and private sectors. Most industry professionals are familiar with the I-Codes as the basis of laws and regulations in communities across the U.S. and in other countries. However, the impact of the codes extends well beyond the regulatory arena, as they are used in a variety of nonregulatory settings, including:

- Voluntary compliance programs such as those promoting sustainability, energy efficiency and disaster resistance.
- The insurance industry, to estimate and manage risk, and as a tool in underwriting and rate decisions.
- Certification and credentialing of individuals involved in the fields of building design, construction and safety.
- Certification of building and construction-related products.
- U.S. federal agencies, to guide construction in an array of government-owned properties.
- Facilities management.
- "Best practices" benchmarks for designers and builders, including those who are engaged in projects in jurisdictions that do not have a formal regulatory system or a governmental enforcement mechanism.
- College, university and professional school textbooks and curricula.
- Reference works related to building design and construction.

In addition to the codes themselves, the code development process brings together building professionals on a regular basis. It provides an international forum for discussion and deliberation about building design, construction methods, safety, performance requirements, technological advances and innovative products.

This code is founded on principles intended to establish provisions consistent with the scope of a green construction code that adequately protects the public health, safety and welfare; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products, or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction. This is achieved by comprehensive provisions that are enforceable, useable and adoptable.

Foreward

The 2018 International Green Construction Code is the third edition of the IgCC. In 2015, ICC and ASHRAE partnered in the development of this new version of the IgCC sponsored by AIA, ASHRAE, ICC, IES and USGBC. The previous two editions (2012 and 2015) were developed utilizing ICC's Code Development Process as part of the ICC Family of Codes.

As part of the partnership with ASHRAE, the responsibility for code provisions is now split between the ICC and ASHRAE processes. ICC is responsible for Chapter 1, Scope and Administration. ICC coordinated the technical provisions developed by ASHRAE with the provisions in Chapter 1 of the 2015 IgCC. The remainder of the code is the technical content that is based on the provisions of the 2017 edition of ANSI/ASHRAE/ICC/USGBC Standard 189.1, Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings (Standard 189.1) developed using the American National Standards Institute (ANSI)-approved ASHRAE consensus process. The Standing Standards Project Committee 189.1 (SSPC) serves as the consensus body that developed the standard.

USER NOTE: The code is formatted utilizing ICC's code format for chapter and section number designations. However, in order to provide the requisite road map to the technical provisions of Standard 189.1, the Standard 189.1 section number is included in parentheses following the IgCC section number – e.g., "Section 101.2 (1.) Purpose." The IgCC section number is 101.2 and the corresponding section number/title in Standard 189.1 is "Section 1 Purpose." In some cases where the text of the IgCC is based on Standard 189.1, the text has been edited to be consistent with ICC's publication style guidelines.

Scope and Administration (ICC – Chapter 1)

As noted previously, the provisions in Chapter 1 are primarily based on Chapter 1 of the 2015 IgCC. The text of Section 101 has been coordinated and correlated with Standard 189.1 Sections 1, 2 and 4 entitled "Purpose," "Scope" and "Administration and Enforcement," respectively. Sections 102 – 109 are basically identical to those contained in the 2015 edition of the IgCC as there are no corresponding Standard 189 sections.

Technical Content (ASHRAE – Chapters 2 – end, including appendices)

The technical content of the code contains the provisions from Standard 189.1, which was originally published in 2009 through a collaborative effort involving ASHRAE, IES, and USGBC. In 2015, ICC was added as an additional cosponsor of the standard, which reflected a Memorandum of Understanding signed in 2014 by ASHRAE, AIA, ICC, IES, and USGBC to better align green building goals through Standard 189.1, the IgCC, and the LEED certification system. As part of that agreement, the 2017 edition of Standard 189.1 serves as the technical content of this code. Prior to this agreement, the 2012 and the 2015 versions of the IgCC included Standard 189.1 as a project compliance option.

Building projects, which are defined in Standard 189.1 (and now in the IgCC), including both the building and the site, result in significant energy and environmental impacts through their design, construction, and operation. The U.S. Green Building Council reports that buildings in the United States produce 40% of U.S. carbon dioxide emissions, are responsible for 41% of U.S. energy consumption, account for 14% of U.S. potable water consumption, and use 40% of raw materials in their construction and operation. In addition, building development frequently converts land from biologically diverse natural habitat that helps manage rainwater to impervious hardscape with reduced biodiversity. While buildings consume energy and have other environmental impacts, they exist primarily to serve occupants who live, work, and otherwise use buildings. Buildings also contribute significantly to national economies. Based on a combination of research and practical experience, it is clear that buildings can provide these services with reduced energy use, greenhouse gas emissions, water use, construction waste, heat island and light pollution effects, and impacts on the atmosphere and other resources. Furthermore, a 2015 Economic Impact Study by the USGBC finds that the U.S. green building industry supports over 2 million jobs annually and results in a median state average economic contribution of $934 million.

The far-reaching influence of buildings, and the benefits provided by high-performance green buildings, have led many organizations to pursue efforts to reduce their energy and environmental impacts. Based on ASHRAE's and the

other cosponsors' ongoing responsibilities to support such actions, Standing Standard Project Committee (SSPC) 189.1 has contributed to building sustainability goals by updating Standard 189.1 in response to input from the building community, the public at large, and project committee members. Compliance with this code will further reduce energy and environmental impacts through high-performance building design, construction, and operation, while providing indoor environments that support the activities, health, and comfort of building occupants and contribute positively to local economics by providing high-quality jobs and conserving natural resources.

The project committee considers a variety of factors in developing the provisions of Standard 189.1, including published research, justification for proposals received from outside the committee, and ultimately the committee members' professional judgment. Cost-benefit assessment, while an important consideration, is not a necessary criterion for inclusion of any given requirement in Standard 189.1. However, the practicality and existing application of any new requirements are considered before they are included.

Standard 189.1, and now the IgCC, address site sustainability, water use efficiency, energy use efficiency, indoor environmental quality, materials and resources, and construction and plans for operation. The 2017 edition of Standard 189.1 reflects the approval of 75 separate addenda to the 2014 edition. Some highlights among these changes include the following:

- General. Clarified the purpose and scope; revised the purpose to add resilience and a statement of intent that the document be broadly adoptable.
- Site. Updated requirements for pedestrian walkways, allowable sites, prohibited development, neighborhood assets, public transit access, and electric vehicle charging infrastructure; added new requirements for vegetated roofs, bicycle paths, and construction waste management.
- Water. Made all of the water efficiency requirements mandatory, eliminating the performance option in Chapter 6; updated requirements for irrigation of plants; added new requirements for water-bottle filling stations, reverse osmosis, and water softeners when they are part of the building design, and for preplumbing of dual plumbing systems when reclaimed or other alternate water sources are expected to become available in the future.
- Energy. Updated requirements to reflect changes in ANSI/ASHRAE/IES Standard 90.1-2016, including reference to Climate Zone 0; updated lighting tables with improved efficiencies; updated equipment efficiency tables; revised envelope requirements (with associated revisions to an informative appendix); conversion of Energy Performance Option A to use the Performance Cost Index; and updated CO2 emission factors for different energy sources; added new requirements for automated demand response and deleted Energy Performance Option B; added a new informative appendix with an energy compliance path that builds on the International Energy Conservation Code (IECC) instead of Standard 90.1.
- IEQ. Updated requirements for control of soil gas entry, material emissions, acoustical control, and daylighting; added new requirements for control of moisture associated with envelope infiltration and HVAC systems, venting of combustion products to the outdoors, IEQ surveys of building occupants, and glare control.
- Materials and resources. Revised the section title and scope; updated requirements for lifecycle assessment.
- Construction and plans for operation. Updated requirements for commissioning and envelope airtightness testing; added a new informative appendix with additional information on the commissioning process.

For Standard 189.1 and now this edition of the IgCC, all chapters other than Chapters 5, 6, and 10 use the following format:

xxx.1 General. This subsection includes a statement of scope and addresses other broad issues for the section.

xxx.2 Compliance Paths. This subsection indicates the compliance options available within a given section.

xxx.3 Mandatory Provisions. This subsection contains mandatory provisions that apply to all projects (i.e., provisions that must be met and may not be ignored in favor of provisions found in other subsections).

xxx.4 Prescriptive Option. This subsection, an alternative to the Performance Option, contains prescribed provisions that must be met in addition to all mandatory provisions. Prescribed provisions offer a simple compliance approach that involves minimal calculations.

xxx.5 Performance Option. This subsection, an alternative to the Prescriptive Option, contains performance-based provisions that must be met in addition to all mandatory provisions. Performance provisions offer a more complex alternate compliance approach that typically involves simulation or other calculations.

Maintenance

The maintenance responsibilities for updating the IgCC are shared between ICC and ASHRAE, as follows:

Scope and Administration (Chapter 1: ICC process)

Chapter 1 of the International Green Construction Code will be kept up to date through the review of proposed changes submitted by code enforcement officials, industry representatives, design professionals and other interested parties. Proposed changes are carefully considered through an open code development process in which all interested and affected parties may participate.

The ICC Code Development Process reflects principles of openness, transparency, balance, due process and consensus, the principles embodied in OMB Circular A-119, which governs the federal government's use of private-sector standards. The ICC process is open to anyone; there is no cost to participate, and people can participate without travel cost through the ICC's cloud-based app, cdpAccess©. A broad cross section of interests are represented in the ICC Code Development Process. The codes, which are updated regularly, include safeguards that allow for emergency action when required for health and safety reasons.

The code development committees evaluate and make recommendations regarding proposed changes to the codes. Their recommendations are then subject to public comment and council-wide votes. The ICC's governmental members—public safety officials who have no financial or business interest in the outcome—cast the final votes on proposed changes.

The contents of this work are subject to change through the code development cycles and by any governmental entity that enacts the code into law. For more information regarding the code development process, contact the Codes and Standards Development Department of the International Code Council. The next opportunity to propose changes to Chapter 1 of the IgCC will be ICC's 2019 Group A Code Development Process. For more information, go to ICC's website at iccsafe.org.

Technical Content (Chapters 2 - end, including appendices: ASHRAE process)

The technical content of this code is based on Standard 189.1. SSPC 189.1 considers and administers changes to Standard 189.1 as a continuous maintenance standard and provides interpretations as requested. Proposed changes to the standard may originate within or outside of the committee. The committee welcomes proposals for improving the standard using the ANSI-approved ASHRAE continuous maintenance procedure. A continuous maintenance proposal (CMP) form can be found online at https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-and-guidelines-under-continuous-maintenance, and may be completed and submitted at any time. The committee takes formal action on every proposal received, which may lead to changes to the published standard. ASHRAE posts approved addenda in publication notices on the ASHRAE website. To receive notice of all public reviews, approved and published addenda, errata, and interpretations as well as meeting notices, ASHRAE encourages interested parties to sign up for the free ASHRAE Internet Listserv for Standard 189.1. (https://www.ashrae.org/technical-resources/standards-and-guidelines/project-committee-list-servers).

Coordination of the International Codes

The coordination of code provisions is one of the strengths of the ICC family of model codes. The codes can be used as a complete set of complementary documents, which will provide users with full integration and coordination of provisions. Individual codes can also be used in subsets or as stand-alone documents.

Italicized Terms

Words and terms that are defined in Chapter 3, Definitions, Abbreviations, and Acronyms are italicized where they appear in code text. Where such words and terms are not italicized, common-use definitions apply. The words and terms selected have code-specific definitions that the user should read carefully to facilitate better understanding of the code.

Adoption

While the I-Code development procedure is thorough and comprehensive, the ICC, its members and those participating in the development of the codes disclaim any liability resulting from the publication or use of the I-Codes, or from compliance or noncompliance with their provisions. The ICC does not have the power or authority to police or enforce compliance with the contents of this code.

To facilitate adoption, sections of this code contain blanks for fill-in information that needs to be supplied by the adopting jurisdiction as part of the adoption legislation. For this code, please see:

Section 101.1. Insert: [NAME OF JURISDICTION]

02_Effective Use of the International Green Construction Code | 2018 2018 International Green Construction Code® (IgCC®) | ICC premiumACCESS

SourceURL: https://codes.iccsafe.org/content/IGCC2018/effective-use-of-the-international-green-construction-code

Effective Use of the International Green Construction Code

Informative Note: Corresponding ASHRAE 189.1 section numbers have not been included in this Effective Use section but have been included throughout the chapters and appendices of this code.

The International Green Construction Code® (IgCC®) is a model code that provides minimum requirements to safeguard the environment, public health, safety and general welfare through the establishment of requirements that are intended to reduce the negative impacts and increase the positive impacts of the built environment on the natural environment and building occupants. The IgCC is fully compatible with the ICC family of codes, including the International Building Code® (IBC®), the International Code Council Performance Code® (ICCPC®), the International Energy Conservation Code® (IECC®), the International Existing Building Code® (IEBC®), the International Fire Code® (IFC®), the International Fuel Gas Code® (IFGC®), the International Mechanical Code® (IMC®), the International Plumbing Code® (IPC®), the International Private Sewage Disposal Code® (IPSDC®), the International Property Maintenance Code® (IPMC®), the International Residential Code® (IRC®), the International Swimming Pool and Spa Code® (ISPSC®), the International Wildland-Urban Interface Code® (IWUIC®), and the International Zoning Code® (IZC®).

The IgCC addresses site sustainability, water and energy efficiency, indoor environmental quality, materials and resources, building commissioning, construction and plans for operations and maintenance for new and certain types of existing buildings, building sites and building materials, components, equipment and systems (see Section 101.3.1). The code will be promulgated on a

3-year cycle to allow for new construction methods and technologies to be incorporated into the code. Innovative approaches and alternative materials, designs, and methods not specifically addressed in this code can be approved by the code official where the proposed innovative approaches or materials, designs or methods comply with the intent of the provisions of the code (see Section 105.4).

The IgCC applies to all occupancies other than single-family dwellings and multifamily dwellings that are three stories or less in height (see Section 101.3.2). See discussion below for additional information in Appendix J for residential construction.

Arrangement and Format of the 2018 IgCC

Before applying the requirements of the IgCC, it is beneficial to understand its arrangement and format.

Chapter	Subjects
1	Scope and administration
2	Reserved
3	Definitions, abbreviations and acronyms
4	Reserved
5	Site sustainability
6	Water use efficiency
7	Energy efficiency
8	Indoor environmental quality (IEQ)
9	Materials and resources
10	Construction and plans for operation
11	Normative references
Normative Appendix A	Climate zones and prescriptive building envelope and duct insulation tables
Normative Appendix B	Prescriptive equipment efficiency tables for the alternate reduced renewables and increased equipment efficiency approach in Section 701.4.1.1.2 (7.4.1.1.2)
Normative Appendix C	Performance option for energy efficiency
Normative Appendix D	Building concentrations
Informative Appendix E	Building envelope tables
Informative Appendix F	Integrated design
Informative Appendix G	Informative references
Informative Appendix H	Option for energy efficiency using the IECC prescriptive compliance path
Informative Appendix I	Additional guidance for functional and performance testing (FPT) and the commissioning (Cx) process
Informative	Option for residential compliance using the National Green

Appendix J	Building Standard
Informative Appendix K	Addenda description information
Annex 1	Referenced standard reproduction annex—ASHRAE Standard 169

The following is a chapter-by-chapter synopsis of the scope and intent of the provisions of the International Green Construction Code:
Chapter 1 Scope and Administration. Chapter 1 of the IgCC establishes the limits of applicability of the code and describes the manner in which the code is to be applied and enforced. Chapter 1 is divided into two parts: Part 1 – Scope and Application (Sections 101 and 102); and Part 2 – Administration and Enforcement (Sections 103 – 109).

Section 101 identifies which buildings and structures come under its purview and Section 102 references other adopted I-Codes as applicable. Section 103 establishes the duties and powers of the code official, including enforcement and the authority granted to the code official to make inspections. Section 105 provides guidance to the code official in the approval of materials, methods of construction, designs, systems and innovative approaches where they are not specifically prescribed in the IgCC. Section 106 identifies the permitting process.

The provisions of Chapter 1 also establish the rights and privileges of the design professional, contractor and property owner.

The IgCC is intended to be adopted as a legally enforceable document and it cannot be effective without adequate provisions for its administration and enforcement.

Chapter 2 Reserved.

Chapter 3 Definitions, Abbreviations and Acronyms. All terms that are defined in the code are listed alphabetically in Chapter 3. Codes are technical documents and every word, term and punctuation mark can impact the meaning of the code text and the intended results. The code often uses terms that have a unique meaning in the code and that code meaning can differ substantially from the ordinarily understood meaning of the term as used outside of the code. Where a definition is provided for understanding a particular code provision, the term is shown in italics wherever it appears in the code. The generally understood meaning of a term or phrase might not be sufficient or consistent with the meaning prescribed by the code; therefore, it is essential that the codedefined meaning be known.

Definitions are deemed to be of prime importance in establishing the meaning and intent of the code text that uses code-defined terms. The user of the code should be familiar with and consult this chapter because the definitions are essential to the correct interpretation of the code and because the user may not be aware that a term is defined in a manner that is not commonly understood.

Chapter 4 Reserved.

Chapter 5 Site Sustainability. Chapter 5 contains requirements related to the selection and development of sites and the mitigation of heat island effect, light pollution and transportation impact.

Section 501.3 limits the type of sites that can be built upon and the type of development that can occur.

Section 501.3.1.1 limits building sites to within the envelope of an existing building, brownfield sites, greyfield sites and certain limited types of greenfield sites.

Section 501.3.1.2 limits building development relative to elevation of the 100-year flood, near fish and wildlife habitat conservation areas and near wetlands.

Section 501.3.2 requires predesign site inventory and assessment.

Section 501.3.3 regulates plantings on the site.

Section 501.3.4 contains requirements for stormwater management systems.

Section 501.3.5 requires the mitigation of heat island effect.

Section 501.3.6 addresses light pollution.

Section 501.3.7 addresses transportation impacts.

Section 501.3.8.1 addresses building site waste management.

Chapter 6 Water Use Efficiency. Chapter 6 provides requirements that are intended to conserve potable and nonpotable water.

Section 601.3.1 reduces water use on sites by means of requirements related to landscape design and irrigation system design.

Section 601.3.2 regulates water consumption through limitations of fixture and fitting flow rates and by means of requirements related to specific equipment, appliances and HVAC systems and equipment.

Section 601.3.3 regulates water use in ornamental fountains and water features.

Section 601.3.4 requires water metering/monitoring and data collection.

Sections 601.3.5, 601.3.6 and 601.3.7 regulate water softeners, reverse osmosis water treatment systems and on-site reclaimed water treatment systems, respectively.

Where a reclaimed water supply is available or is planned to be available within 5 years, Section 601.3.8 requires the installation of a dual water supply plumbing system wherein reclaimed water is supplied to urinals and water closets.

Chapter 7 Energy Efficiency. Chapter 7 contains requirements related to the effective use of energy in buildings and appliances and to on-site renewable energy systems. Chapter 7 references ANSI/ASHRAE/IES Standard 90.1 and contains many provisions that exceed those in Standard 90.1. It should also be noted that Appendix H is an alternative prescriptive energy compliance path that is built on the prescriptive provisions of the International Energy Conservation Code.

Section 701.2 requires that building projects comply with the mandatory provisions of Section 701.3 and either the prescriptive provisions of Section 701.4 or the performance provisions of Section 701.5.

Section 701.3 contains mandatory provisions that are applicable to both the prescriptive and performance compliance paths. It includes provisions related to air barriers, on-site renewable energy systems, energy consumption management and automated demand response systems.

Section 701.4 contains the prescriptive-based energy compliance path. It includes provisions related to renewable energy systems, the building envelope, HVAC systems, service water heating, power, lighting and various other equipment.

Section 701.5 contains the performance-based energy compliance path. It is based on an annual energy cost concept that builds on Normative Appendix G of ANSI/ASHRAE/IES Standard 90.1. Compliance with Normative Appendix C of this code is also required for on-site renewable energy systems in the proposed design. Section 701.5.2 sets maximum annual carbon dioxide equivalent requirements.

Chapter 8 Indoor Environmental Quality (IEQ). Chapter 8 is intended to ensure that the building's interior environment is conducive to the health of building occupants.

Section 801.2 requires compliance with the mandatory provisions of Section 801.3 and either the prescriptive-based provisions of Section 801.4 or the performance-based provisions of Section 801.5.

Section 801.3 contains mandatory provisions related to indoor air quality, thermal environmental conditions, acoustical control, soil gas control, lighting quality, moisture control and glare control.

Section 801.4 contains prescriptive-based provisions related to indoor environmental quality. It includes requirements for daylighting, material volatile organic compound emissions and contents and lighting for presentations.

Section 801.5 contains performance-based provisions related to indoor environmental quality. It includes requirements for daylight simulation, material VOC emissions and lighting for presentations.

Chapter 9 Materials and Resources. Chapter 9 addresses the human health and environmental impacts of materials.

Section 901.2 requires that buildings comply with the mandatory provisions of Section 901.3 and either the prescriptive-based provisions of Section 901.4 or the performance-based provisions of Section 901.5.

Section 901.3 contains mandatory provisions related to the human health and environmental impacts of materials. It includes requirements for construction waste management; the extracting, harvesting and manufacturing of materials; refrigerants; the storage and collection of recyclables and discarded goods and the mercury content levels of lamps.

Section 901.4 contains prescriptive-based requirements related to the human health and environmental impacts of materials. It includes provisions for recycled and salvaged material content, regional materials, biobased products and multiple-attribute product declaration/certification.

Section 901.5 contains performance-based requirements related to the health and environmental impacts of materials. It includes provisions for life-cycle assessment that address performance metrics, procedures and reporting.

Chapter 10 Construction and Plans for Operation. Chapter 10 addresses building commissioning and functional and performance testing during construction and requires plans for the subsequent operation and maintenance of building projects.

Section 1001.3.1.1 regulates the functional and performance testing of building systems.

Section 1001.3.1.2 regulates the building commissioning process.

Section 1001.3.1.3 regulates the documentation of the commissioning process.

Section 1001.3.1.4 regulates erosion and sedimentation control during construction.

Section 1001.3.1.5 regulates indoor air quality during construction.

Section 1001.3.1.6 regulates moisture control during construction.

Section 1001.3.1.7 addresses pollution from the idling of construction vehicles during construction.

Section 1001.3.1.8 addresses contaminant entry into buildings during construction.

Section 1001.3.1.9 requires post-construction testing for radon in buildings.

Section 1001.3.1.10 requires construction waste management during construction.

Section 1001.3.2 requires plans for building project operation. These plans are intended to help and encourage building owners and facility management staff to operate and maintain building projects in a manner, and at a performance level, as was originally intended by this code.

Section 1001.3.2.3 requires that a service life plan be developed for the building project.

Section 1001.3.2.4 requires that a transportation management plan be developed.

Chapter 11 Normative References. The code contains numerous references to standards that are used to regulate materials and methods of construction. Chapter 11 contains a comprehensive list of all standards that are referenced in the code. The standards are part of the code to the extent of the reference to the standard (see Sections 102.4, 102.4.1 and 102.4.2). Compliance with the referenced standard is necessary for compliance with this code. By providing specifically adopted standards, the construction and installation requirements necessary for compliance with the code can be readily determined. The basis for code compliance is, therefore, established and available on an equal basis to the code official, contractor, designer and owner.

Chapter 11 is organized in a manner that makes it easy to locate specific standards. It lists all of the referenced standards, alphabetically, by acronym of the promulgating agency of the standard. Each agency's standards are then listed in either alphabetical or numeric order based on the standard identification. The list also contains the title of the standard; the edition (date) of the standard referenced; any addenda included as part of the ICC adoption of the IgCC; and the section or sections of this code that reference the standard.

Appendices. User note: Appendices in this edition of the IgCC are treated differently than the appendices in the other I-Codes (see Sections 101.4.3 and 101.4.4).

In the IgCC, the technical content is based on Standard 189.1, including the appendices. These appendices are identified in two categories:

- Normative appendices. As noted in Section 101.4.3, where a normative appendix is referenced in the code, it is considered part of the mandatory provisions of the code.
- Informative appendices. As noted in Section 101.4.4, these appendices provide additional information but are not mandatory provisions and therefore are not part of the code.

Normative Appendix A Climate Zones and Prescriptive Building Envelope and Duct Insulation Tables. This appendix is referenced in the definition of “climate zone” and Sections 701.4.2.1, 701.4.2.2 and 701.4.3.9. This appendix includes a mandatory reference to ANSI/ASHRAE Standard 169 to determine the applicable climate zone to be used in conjunction with Chapter 7 and includes minimum roof and duct insulation values.

Normative Appendix B Prescriptive Equipment Efficiency Tables for the Alternate Reduced Renewables and Increased Equipment Efficiency Approach in Section 701.4.1.1.2 (7.4.1.1.2). This appendix is referenced in Sections 701.4.1.1.2, 701.4.3.1, 701.4.4.1, 701.4.7.1 and 701.4.7.3.2. This appendix provides mandatory equipment efficiency information for the different types of mechanical equipment utilized for heating and cooling.

Normative Appendix C Performance Option for Energy Efficiency. This appendix is referenced in Section 701.5.1. This appendix provides a mandatory reference to ANSI/ASHRAE/IES Standard 90.1 for modeling requirements for on-site renewable energy systems and the required information to perform building performance calculations.

Normative Appendix D Building Concentrations. This appendix is referenced in Section 801.5.2. This appendix provides mandatory criteria to estimate building concentrations of materials for individual VOC concentrations.

Informative Appendix E Building Envelope Tables. As an informative appendix, this appendix is not referenced in the body of the code and is therefore not part of the code. This appendix provides R-values for common building assemblies such as roofs, walls, floors and doors. It also includes common fenestration values for glazed areas.

Informative Appendix F Integrated Design. As an informative appendix, this appendix is not referenced in the body of the code and is therefore not part of the code. This appendix provides details and concepts on the need for early collaboration in order to increase the predictability of project outcomes as early as possible in the design phase of the project. See Chapter 3 definition for “integrated design process.”

Informative Appendix G Informative References. Even though this is an informative appendix, it is cited in Sections 101.4.2, 701.5.1 and 701.5.2, as well as Appendices B and C. However, as an informative appendix, it is not part of the code. This appendix includes potentially useful source documents that may be consulted.

Informative Appendix H Option for Energy Efficiency Using the IECC Prescriptive Compliance Path. As an informative appendix, this appendix is not referenced in the body of the code and is therefore not part of the code. This appendix provides an option for prescriptive energy compliance that is based on requirements in the International Energy Conservation Code (IECC). This approach allows the use of the prescriptive provisions of the IECC without directly relying on the energy provisions of ANSI/ASHRAE/IES Standard 90.1.

Appendix H includes provisions related to renewable energy systems, the building envelope, HVAC systems, service water heating, power, lighting and various other equipment.

Informative Appendix I Additional Guidance for Functional and Performance Testing (FPT) and the Commissioning (Cx) Process. As an informative appendix, this appendix is not referenced in the body of the code and is therefore not part of the code. This appendix provides guidance on best practices for performance testing and commissioning. See Chapter 3 definitions for “functional and performance testing (FPT)” and “commissioning (Cx) process.”

Informative Appendix J Option for Residential Compliance Using the National Green Building Standard. This appendix is cited in an informative note in Section 101.3. As an informative appendix, this appendix is not referenced in the body of the code and is therefore not part of the code. This appendix provides an option for residential compliance using the National Green Building Standard. The provisions in the appendix are mandatory only when specifically adopted. The provisions can be adopted in total or by individual section(s) at the discretion of the authority having jurisdiction.

Informative Appendix K Addenda Description Information. As an informative appendix, this appendix is not referenced in the body of the code and is therefore not part of the code. This appendix provides the roadmap of approved addenda to the 2014 edition of Standard 189.1 which resulted in the 2017 edition of Standard 189.1 which forms the technical content for this code. As can be seen by the list, there were 75 addenda to the 2014 edition.

Annex 1 Referenced Standard Reproduction Annex ASHRAE Standard 169. This annex contains pertinent information from ASHRAE Standard 169 for assessing climate zones. See also Normative Appendix A.

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PART1—SCOPE AND APPLICATION

SECTION101 GENERAL

101.1Title.

These regulations shall be known as the Green Construction Code of [NAME OF JURISDICTION] hereinafter referred to as “this code.”

101.2 (1.)Purpose.

101.2.1 (1.1)

The purpose of this code is to provide minimum requirements for the siting, design, construction, and plans for operation of high-performance green buildings to: reduce emissions from buildings and building systems; enhance

building occupant health and comfort; conserve water resources; protect local biodiversity and ecosystem services; promote sustainable and regenerative materials cycles; enhance building quality; enhance resilience to natural, technological, and human-caused hazards; and support the goal of development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

101.2.2 (1.2)

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

101.3 (2.)Scope.

101.3.1 (2.1)

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

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

101.3.2 (2.2)

The provisions of this code do not apply to the following:

1. Single-family dwellings.
2. Multifamily dwellings of three stories or fewer above grade.
3. Manufactured houses (mobile homes).
4. Manufactured houses (modular).
5. 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 Chapters 5 through 11. Within each of these chapters, building projects shall comply with all mandatory provisions (x.3) and, where offered, either the:

1.Prescriptive Option (x.4) or
2.Performance Option (x.5).

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. 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.

SECTION102 APPLICABILITY

102.1Code 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.

102.2Other laws.

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

102.3Application 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.

102.4Referenced codes and standards.

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

102.4.1Conflicting 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.

102.4.2Application of referenced standards.

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

102.5Partial 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.

102.6Existing 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, the

International Property Maintenance 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.

102.7Mixed 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.

04_CHAPTER 3 DEFINITIONS, ABBREVIATIONS AND ACRONYMS | 2018 2018 International Green Construction Code® (IgCC®) | ICC premiumACCESS

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CHAPTER 3
DEFINITIONS, ABBREVIATIONS AND ACRONYMS

301.1 (3.1) General.

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

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

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

301.2 (3.2) Definitions.

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

air, makeup: see ANSI/ASHRAE Standard 62.1.

air, outdoor: see ANSI/ASHRAE Standard 62.1.

air, transfer: see ANSI/ASHRAE Standard 62.1.

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

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

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

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

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

automatic: see ANSI/ASHRAE/IES Standard 90.1.

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

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

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

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

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

biodiverse plantings: nonhomogeneous, multiple-species plantings.

breathing zone: see ANSI/ASHRAE Standard 62.1.

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

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

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

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

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

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

climate zone: see Normative Appendix A.

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

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

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

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

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

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

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

contaminant: see ANSI/ASHRAE Standard 62.1.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ET_c: *evapotranspiration* of the *plant* material derived by multiplying ET_o by the appropriate *plant* factor or coefficient.

ET_o: reference *evapotranspiration* for a cool-season grass as calculated by the standardized Penman-Monteith equation based on weather-station data.

fenestration: see ANSI/ASHRAE/IES Standard 90.1.

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

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

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

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

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

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

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

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

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

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

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

ground cover: plantings other than *turfgrass* that are lowgrowing 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 supports the health of occupants, and enhances satisfaction and productivity of occupants through integration of environmentally preferable building materials and water-efficient and energy-efficient systems.

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

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

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

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

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

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

integrated project delivery: see *integrated design process*.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

nonresidential: see ANSI/ASHRAE/IES Standard 90.1.

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

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

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

occupiable space: see ANSI/ASHRAE Standard 62.1.

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

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

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

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

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

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

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

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

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

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

plants:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

residential: see ANSI/ASHRAE/IES Standard 90.1.

roof: see ANSI/ASHRAE/IES Standard 90.1.

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

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

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

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

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

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

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

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

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

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

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

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

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

skylight: see ANSI/ASHRAE/IES Standard 90.1.

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

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

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

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

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

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

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

space: see ANSI/ASHRAE/IES Standard 90.1.

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

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

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

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

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

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

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

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

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

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

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

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

a. It provides building occupants with a view to the outdoors or to an interior daylit atrium.
b. It has undiffused glazing with a haze value less than 3%, as determined in accordance with ASTM D1003.
c. It has a center-of-glass visible transmittance (VT) of not less than 20%.
d. The product of the center-of-glass VT and the openness factor of screens, patterned films, and ceramic frits is not less than 20%.
e. Where *dynamic glazing* is provided, such glazing has a center-of-glass VT of not less than 20% at the highest end of its range.
f. Where nonoperable opaque window treatments are provided, such as blinds, shades, and louvers, such treatments do not obstruct more than 40% of the *fenestration* glazing area.

wall: see ANSI/ASHRAE/IES Standard 90.1.

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

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

a. rainwater or stormwater harvesting,
b. air conditioner condensate,
c. grey water from interior applications and treated as required,
d. swimming-pool filter backwash water,
e. cooling-tower blowdown water,
f. foundation drain water,
g. industrial process water, and
h. on-site wastewater treatment *plant* effluent.

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

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

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

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

water factor (WF):

a. ***clothes washer* (*residential* and *commercial*):** the quantity of water in gallons (litres) used to wash each cubic foot (cubic metre) of machine capacity.
b. ***residential dishwasher*:** the quantity of water use in gallons (litres) per full machine wash and rinse cycle.

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

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

301.3 (3.3) Abbreviations and Acronyms

µg	microgram
AC	alternating current
AHJ	*authority having jurisdiction*
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
ANSI	American National Standards Institute
ASE	*annual sunlight exposure*
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials International
BIFMA	The Business and Institutional Furniture Manufacturer's Association
BMS	building management system
BoD	*Basis of Design*
BPF	building performance factor
Btu	British thermal unit
Btu/h	British thermal unit per hour
BUG	backlight, uplight, and glare
CAC	ceiling attenuation class
CCOP	*combined coefficient of performance*
CDPH	California Department of Public Health
CEER	*combined energy efficiency ratio*
CFC	Chlorofluorocarbon
cfm	cubic feet per minute (ft^3/min)
CH_4	methane
c.i.	continuous insulation
CIE	Commission Internationale de L'Eclairage (International Commission on Illumination)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO_2	carbon dioxide

CO_2e	*carbon dioxide equivalent*
CSA	Canadian Standards Association
cSTC	composite sound transmission class
Cx	commissioning
dB	decibel
db	dry bulb
dBA	decibel, A-weighting
dBC	decibel, C-weighting
DC	direct current
DCV	*demand control ventilation*
DR	demand response
EISA	Energy Independence and Security Act
EMS	Energy Management System
EPAct	U.S. Energy Policy Act
EPD	environmental product declaration
ESC	erosion and sedimentation control
ET_c	*evapotranspiration*
ET_o	*maximum evapotranspiration*
ETS	environmental tobacco smoke
fc	footcandle
FF&E	furniture, fixtures, and equipment
FPT	*functional and performance testing*
ft	foot
gal	gallon
gpm	gallons per minute
GWP	global warming potential
h	hour
ha	hectare
HCFC	hydrochlorofluorocarbon
HID	high-intensity discharge
HVAC	heating, ventilation, and air conditioning
HVAC&R	heating, ventilation, air conditioning, and refrigeration
Hz	hertz
IA	Irrigation Association
IAPMO	International Association of Plumbing and Mechanical Officials
IAQ	indoor air quality
IECC	International Energy Conservation Code
IEQ	indoor environmental quality
IES	Illuminating Engineering Society
IIC	impact insulation class
in.	inch
I-P	inch-pound
ISR	impact sound rating
kg	kilogram
km	kilometre
kVA	kilovolt-ampere
kW	kilowatt
kWh	kilowatt-hour
L	litre
lb	pound
LCA	*life-cycle assessment*
LCI	life-cycle inventory
L_{eq}	hourly average sound pressure level
L_{max}	*maximum sound pressure level*
LPD	lighting power density
Ls	*liner system*
LZ	*lighting zone*
m	metre
MDF	medium density fiberboard
MERV	minimum efficiency reporting value
mg	milligram
mi	mile
min	minute
mm	millimetre
mph	miles per hour
M&V	measurement and *verification*
N_2O	nitrous oxide
NA	not applicable
NAECA	National Appliance Energy Conservation Act
NIC	noise isolation class

NISR	normalized impact sound rating
NNIC	normalized noise isolation class
NPLV	nonstandard part-load value
NR	not required
OITC	outdoor-indoor transmission class
O&M	operations and maintenance
OPR	*owner's project requirements*
Pa	Pascal
PCI	Performance Cost Index
PF	*projection factor*
ppm	parts per million
RCR	room cavity ratio
REC	*renewable energy certificate*
s	second
SCAQMD	South Coast Air Quality Management District
sDA	*spatial daylight autonomy*
SHGC	*solar heat gain coefficient*
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SRI	*solar reflectance index*
STC	sound transmission class
SWAT	smart water application technology
T_{60}	reverberation time in seconds
UL	Underwriters Laboratory
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFEMA	United States Federal Emergency Management Agency
USGBC	United States Green Building Council
VAV	*variable air volume*
VOC	volatile organic compound
VRF	variable refrigerant flow system
VT	visible transmittance
wb	wet bulb
WF	*water factor*
yr	year

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2018 2018 International Green Construction Code® (IgCC®)

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CHAPTER5 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.

All of the provisions of Chapter 5 (Section 5) are mandatory provisions.

501.3 (5.3)Mandatory Provisions.

501.3.1 (5.3.1)Site Selection.

The building project shall comply with Sections 501.3.1.1 (5.3.1.1) and 501.3.1.2 (5.3.1.2).

501.3.1.1 (5.3.1.1)Allowable Sites.

The building project shall take place in or on one of the following:

a.An existing building envelope.
b.A brownfield.
c.A greyfield.
d.A greenfield that is within 1/2 mi (800 m) of residential land that is developed, or that has one or more buildings under construction, with an average density of ten dwelling units per acre (4 units per ha) unless that site is agricultural land or forest land. Proximity is determined by drawing a circle with a 1/2 mi (800 m) radius around the center of the proposed site.
e.A greenfield where the proposed building complies with ASTM E2843, unless that site is agricultural land or forest land.
f.A greenfield where the proposed building complies with ASTM E2844, unless that site is agricultural land or forest land.
g.A greenfield that is agricultural land, and the purpose of the proposed building is related to the agricultural use of the land.
h.A greenfield that is forest land, and the purpose of the proposed building is related to the forestry use of the land.
i.A greenfield that is designated park land, and the purpose of the proposed building is related to the use of the land as a park.

501.3.1.2 (5.3.1.2)Prohibited Development Activity.

There shall be no site disturbance or development of the following:

a.Previously undeveloped land having an elevation lower than 5 ft (1.5 m) above the elevation of the 100-year flood, as defined by USFEMA.

Exceptions:

1.Development of low-impact trails shall be allowed anywhere within a flood zone.
2.Development of building structures shall be allowed in alluvial “AO” designated flood zones, provided that such structures include engineered floodproofing up to an elevation that is at least as high as the minimum lowest floor elevation determined by the authority having jurisdiction (AHJ) and provided that the site includes drainage paths constructed to guide floodwaters around and away from the structures.

b.Land within 150 ft (50 m) of any fish and wildlife habitat conservation area.

Exceptions:

1.Development of low-impact trails shall be allowed, provided that such trails are located at least 15 ft (4.5 m) from the area.
2.Site disturbance or development shall be allowed for habitat enhancement measures.

c.Land within 100 ft (35 m) of any wetland

Exceptions:

1.Development of low-impact trails shall be allowed, provided that such trails are located at least 15 ft (4.5 m) from the wetland.
2.Site disturbance or development shall be allowed for habitat enhancement measures or for restoration of the functions of the wetland.

501.3.2 (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 any prohibited development areas identified in Section 501.3.1.2 (5.3.1.2) that are 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 shall be removed from the building project site and destroyed or disposed of in a land fill. Invasive plants shall not be planted on the building project site.

501.3.3.2 (5.3.3.2)Greenfield Sites.

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 of 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 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 spreaders, constructed wetlands, planters, and open space with plantings.
2.A minimum of 60% of the vegetated area shall consist of biodiverse planting of native plants and/or adapted plants other than turfgrass.

Exception: The following areas shall not be included in the calculations: dedicated sports fields, driving ranges, burial grounds,

vegetated pavers, and the minimum fire lanes required by the jurisdiction.

501.3.4 (5.3.4)Stormwater Management.

Stormwater management systems shall be provided on the building site. Except to the extent that other stormwater management approaches are required by a local, state, or federal jurisdiction, these systems shall be limited to one or more of the following management methods:

a.Infiltration.
b.Evapotranspiration.
c.Rainwater harvesting.
d.Stormwater collection and use.

501.3.4.1 (5.3.4.1)Projects on Greenfields.

Projects on greenfields shall comply with at least one of the following:

a.Stormwater management systems shall retain on site no less than the volume of precipitation during a single 24 h period equal to the 95th percentile precipitation event. Building projects with stormwater management systems that are designed to retain volumes greater than that of the 98th percentile precipitation event shall conduct a hydrologic analysis of the building site to determine the water balance of the site prior to its development, clearing, and filling and to demonstrate that the stormwater management system will not cause ecological impairment by starving receiving waters downstream of the site.
b.The stormwater management system design shall maintain site water balance (the combined runoff,infiltration, and evapotranspiration) based on a hydrologic analysis of the site’s conditions prior to development, clearing, and filling. Postconstruction runoff rate, volume, and duration shall not exceed rates preceding development, clearing, or filling of the site.

501.3.4.2 (5.3.4.2)Projects on Greyfields.

Projects on greyfields shall retain on site no less than the volume of precipitation during a single 24 h period equal to or greater than the 60th percentile precipitation event.

Exception: Where any fraction of the 60th percentile precipitation event cannot be retained, that fraction shall be treated to limit total suspended solids to 25 mg/L in the remaining discharge.

501.3.4.3 (5.3.4.3)Discharge Rate.

Building project sites shall be designed and constructed to comply with one of the following requirements:

a.The discharge of the design storm shall occur over a period of not less than 48 h.

b.The discharge flow duration curve at any point in time shall be plus or minus 10% of the flow duration curve for channel-forming discharges for the site prior to its development, clearing, or filling.

501.3.4.4 (5.3.4.4)Adjoining Lots.

The stormwater management system shall direct or concentrate off-site discharge to avoid increased erosion or other drainagerelated damage to adjoining lots or public property.

501.3.4.5 (5.3.4.5)Discharges from Contaminated Soils.

Stormwater management systems on areas of brownfields where contaminated soils are left in place shall not use infiltration practices that will result in pollutant discharges to groundwater. Stormwater discharge from brownfields shall be treated to limit total suspended solids to 25 mg/L. Stormwater management systems shall not penetrate, damage, or otherwise compromise remediation actions at the building site.

501.3.4.6 (5.3.4.6)Coal Tar Sealants.

The use of tar sealants shall be prohibited in any application exposed to stormwater, wash waters, condensates, irrigation water, snowmelt, or icemelt.

501.3.5 (5.3.5)Mitigation of Heat Island Effect.

501.3.5.1 (5.3.5.1)Site Hardscape.

At least 50% of the site hardscape that is not covered by solar energy 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.

Exception: Section 501.3.5.1 (5.3.5.1) shall not apply to building projects in Climate Zones 6, 7, and 8.

501.3.5.2 (5.3.5.2)Walls.

Above-grade building walls and retaining walls shall be shaded in accordance with this section. The building is allowed to be rotated up to 45 degrees to the nearest cardinal orientation for purposes of calculations and showing compliance. Compliance with this section shall be achieved through the use of shade-providing plants, man-made structures, existing buildings, hillsides, permanent building projections, on-site renewable energy systems, or a combination of these, using the following criteria:

a.Shade shall be provided on at least 30% of the east and west above-grade walls and retaining walls from grade level to a height of 20 ft (6 m) above grade, or the top of the exterior wall, whichever is less. Shade coverage shall be calculated at 10 a.m. for the east walls and 3 p.m. for the west walls on the summer solstice.
b.Where shading is provided by vegetation, such vegetation shall be existing trees and vegetation or new biodiverse plantings of native plants and adapted plants. Such planting shall occur 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. Vegetation shall be appropriately sized, selected, planted, and maintained so that it does not interfere with overhead or underground utilities. Trees shall be placed a minimum of 5 ft (1.5 m) from and within 50 ft (15 m) of the building or retaining wall.

Exceptions:

1.The requirements of this section are satisfied if 75% or more of the opaque wall surfaces on the east and west have a minimum SRI of 29. Each wall is allowed to be considered separately for this exception.
2.East wall shading is not required for buildings located in Climate Zones 5, 6, 7, and 8. West wall shading is not required for buildings located in Climate Zones 7 and 8.

501.3.5.3 (5.3.5.3)Roofs.

This section applies to the building and covered parking roof surfaces for building projects in Climate Zones 0, 1, 2, and 3. A minimum of 75% of the roof surface shall be covered with products that:

a.have a minimum three-year-aged SRI of 64 in accordance with Section 501.3.5.4 (5.3.5.4) for roofs with a slope of less than or equal to 2:12.
b.have a minimum three-year-aged SRI of 25 in accordance with Section 501.3.5.4 (5.3.5.4) for roofs with a slope of more than 2:12.

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

a.Roof penetrations and associated equipment.
b.On-site renewable energy systems, including photovoltaics, solar thermal energy collectors, and required access around the panels or collectors.
c.Portions of the roof used to capture heat for building energy technologies.
d.Roof decks and rooftop walkways.
e.Vegetated terrace and roofing systems complying with Section 501.3.5.5 (5.3.5.5).

Exceptions:

1.Building projects where an annual energy analysis simulation demonstrates that the total annual building energy cost and total annual 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.

501.3.5.4 (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.

501.3.5.5 (5.3.5.5)Vegetated Terrace and Roofing Systems.

Vegetated terrace and roofing systems, where provided in accordance with Section 501.3.5.3 (5.3.5.3), shall comply with the following:

a.All plantings shall be capable of withstanding the microclimate conditions of the vegetated area, including but not limited to wind, precipitation, and temperature. Plants shall be selected and placed to provide foliage coverage of not less than 50% of designed area of vegetation based on the anticipated plant growth within two years of the issuance of the final certificate of occupancy. Construction documents shall be submitted that show the planting location and anticipated two-year foliage coverage of the plantings. Duplicate coverage shall not be credited where multiple plants cover the same area. Invasive plants shall not be planted.
b.The growing medium shall be designed for the physical conditions and local climate to support the plants selected. The planting design shall include measures to protect the growing medium until the plants are

established. The maximum wet weight and water-holding capacity of a growing medium shall be determined in accordance with ASTM E2399.
c.Nonvegetated clearances and borders shall be provided in accordance with the International Fire Code, Section 317.
d.Plantings shall be capable of maintaining the function of the vegetated roof or terrace as required by Section 1001.3.2.1.1 (10.3.2.1.1).
e.Irrigation of the vegetated roofs and terraces shall comply with Section 601.3.2.4 (6.3.2.4).
f.Installation of plantings shall be in accordance with the roof-covering manufacturer's installation instructions.

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.

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 LINEa,b

DISTANCE IN MOUNTING HEIGHTS TO NEAREST PROPERTY LINE	LZ0	LZ1	LZ2	LZ3	LZ4

⩾ 1 and < 2	G0	G0	G1	G1	G2
⩾ 0.5 and < 1	G0	G0	G0	G1	G1
< 0.5	G0	G0	G0	G0	G1

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) RATINGSa,b,c,d

	LZ0	LZ1	LZ2	LZ3	LZ4
Allowed Backlight Rating					
> 2 mounting heights from property line	B1	B3	B4	B5	B5
1 to 2 mounting heights from property line	B1	B2	B3	B4	B4
0.5 to 1 mounting height to property line	B0	B1	B2	B3	B3
< 0.5 mounting height to property line	B0	B0	B0	B1	B2
Allowed Uplight Rating	U0	U1	U2	U3	U4
Allowed Glare Rating	G0	G1	G2	G3	G4

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.

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.
12.Lighting in LZ3 and LZ4, solely for uplighting structures, building façades, or landscaping.
13.Lighting in LZ1 and LZ2, solely for uplighting structures, building façades, or landscaping, provided the applicable lighting power densities (LPDs) do not exceed 50% of the lighting power allowances in ANSI/ASHRAE/IES Standard 90.1, Table 9.4.2-2.

TABLE 501.3.6.3 (TABLE 5.3.6.3)

MAXIMUM ALLOWABLE PERCENTAGE OF UPLIGHT

	LZ0	LZ1	LZ2	LZ3	LZ4
Percentage of total exterior fixture lumens allowed to be emitted above 90 degrees or higher from nadir (straight down)	0%	0%	1%	2%	5%

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 points of contact between the bicycle frame and rack. Each space shall have access to a clear exit pathway not less than 36 in. (914 mm) in width.

501.3.7.2.4 (5.3.7.2.4)Ability to Lock.

Each 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)Site Vehicle Provisions.

Where onsite vehicle parking is provided for a building that has a building occupant load greater than 100, at least one of the following shall be provided:

a.Provisions for preferred parking spaces. Not less than 5% of the parking spaces provided shall be designated as preferred parking for vehicles that meet both the minimum greenhouse gas and air pollution scores as required for USEPA SmartWay designation. Where calculation of the parking spaces yields a fraction, such fractions shall be rounded up to the next whole number. Preferred parking spaces shall be located on the shortest route of travel from the parking facility to a building entrance but shall not take precedence over parking spaces that are required to be accessible for individuals with disabilities. Where buildings have multiple entrances with adjacent parking, parking spaces shall be dispersed and located near the entrances. Such parking spaces shall be provided with signage approved by the AHJ that specifies the permitted use.
b.Provisions for electric-vehicle charging infrastructure. The building project shall comply with one of the following:

1.Two or more electric-vehicle charging stations shall be available to the building occupants and shall be located not more than 1/4 mi (400 m) from the building project.
2.Electrical raceways shall be installed and extend from one or more of the building's electrical power distribution panels to not less than the number of parking spaces specified in Table 501.3.7.3 (5.3.7.3) to facilitate the future installation of vehicle charging stations. Electrical power distribution panels serving such raceways shall be sized to supply the future charging stations based on a design load of not less than 40 amp per required parking space at a supply voltage of not less than 208/240 VAC.

TABLE 501.3.7.3 (TABLE 5.3.7.3)

NUMBER OF SPACES REQUIRED TO HAVE RACEWAYS

TOTAL NUMBER OF PARKING SPACES PROVIDED	NUMBER OF SPACES REQUIRED TO HAVE RACEWAY
1 through 25	1
26 through 50	2
51 through 75	4
76 through 100	5
101 through 150	7
151 through 200	10

201 and over	5% of total

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 stumps 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 other than waste-to-energy systems with an energy-recovery efficiency rate higher than 60%. 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.Woody waste to be used as fuel.
f.The destruction and disposal of invasive plant materials.
g.The methods of removal of any contaminated soils.
h.The treatment of vegetation to comply with the rules of government-designated quarantine zones for invasive insect species.

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2018 2018 International Green Construction Code® (IgCC®)

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CHAPTER6
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.

All provisions of Section 6 are mandatory provisions.

601.3 (6.3)Mandatory Provisions.

601.3.1 (6.3.1)Site Water Use Reduction.

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 planting of native plants and rainfall-ETc compatible plants.

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.
3.Where average annual rainfall is less than 12 in. (300 mm), plants other than turfgrass, with an annual ETc of 15 in. (380 mm) or less, shall be deemed equivalent to rainfall-ETc compatible plants.

601.3.1.2 (6.3.1.2)Irrigation.

For golf courses and driving ranges, 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 ETo for turfgrass and 55% of ETo for other plantings. Where municipally reclaimed water is available at a water main within 200 ft (60 m) 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 an 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 stations.
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).

d.Microirrigation zones:

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

601.3.1.2.2 (6.3.1.2.2)Controls.

Where any irrigation system for the project site uses an automatic controller, the system shall be controlled by a qualifying smart controller that uses evapotranspiration (ET) and weather data to adjust irrigation schedules and that complies with the minimum requirements. Alternatively, the system shall be controlled by an on-site rain or moisture sensor 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 ETc.
b.Irrigation excess— not to exceed 10% of ETc.

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 Rainfall-ETc Compatible Plants.

The use of potable water or reclaimed water for irrigation of adapted plants is prohibited after the landscape establishment period. In-ground irrigation systems for rainfall-ETc compatible plants using potable or off-site treated reclaimed water are prohibited. After the landscape establishment period of adapted plants, the irrigation system using potable water or reclaimed water shall be permanently disabled or removed from site.

Exception: Plants deemed equivalent to rainfall-ETc compatible plants by Section 601.3.1.1 (6.3.1.1), Exception 3, shall be exempt from the requirements of Section 601.3.1.3 (6.3.1.3).

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 fittings (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 1.28 gal (4.8 L). For dual-flush, the full-flush volume shall not exceed 1.28 gal (4.8 L) per flush. Dualflush 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 1.28 gal (4.8 L). 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 0.5 gal (1.9 L). 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 0.5 gpm (1.9 L/min) 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 1.5 gpm (5.7 L/min) 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 2.0 gpm (7.6 L/min) 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 2.0 gpm (7.6 L/min).

Exception: Where the area of a shower compartment exceeds 2600 in.2 (1.7 m2), an additional flow of 2.0 gpm (7.6 L/min) 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.

TABLE 601.3.2.1 (TABLE 6.3.2.1)

PLUMBING FIXTURES AND FITTINGS REQUIREMENTS

PLUMBING FIXTURE	MAXIMUM
Water closets (toilets)—flushometer single-flush valve type	Single-flush volume of 1.28 gal (4.8 L)
Water closets (toilets)—flushometer dual-flush valve type	Full-flush volume of 1.28 gal (4.8 L)
Water closets (toilets)—single-flush tank-type	Single-flush volume of 1.28 gal (4.8 L)
Water closets (toilets)—dual-flush tank-type	Full-flush volume of 1.28 gal (4.8 L)
Urinals	Flush volume 0.5 gal (1.9 L)
Public lavatory faucets	Flow rate—0.5 gpm (1.9 L/min)
Public metering self-closing faucet	0.25 gal (1.0 L) per metering cycle
Residential bathroom lavatory sink faucets	Flow rate—1.5 gpm (5.7 L/min)
Residential kitchen faucets	Flow rate—1.8 gpm (6.8 L/min)a
Residential showerheads	Flow rate—2.0 gpm (7.6 L/min)
Residential shower compartment (stall) in dwelling units and guest rooms	Flow rate from all shower outlets total of 2.0 gpm (7.6 L/min)

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

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).
2.Dishwashers—Standard-size dishwashers shall have a maximum WF of 3.8 gal/full operating cycle (14.3 L/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 foodservice 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 chilledwater systems shall be limited in accordance with method (1) or (2):

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

Exception: Where the total dissolved solids concentration of the discharge water exceeds 1500 mg (1500 ppm/L) or the silica exceeds 150 ppm (150 mg/L) measured as silicon dioxide before the above cycles of concentration are reached.
c.Cooling towers and evaporative coolers shall be equipped with makeup and blowdown meters, conductivity controllers, and overflow alarms in accordance with the thresholds listed in Table 601.3.4.1B (6.3.4.1B). Cooling towers shall be equipped with efficient drift eliminators that achieve drift reduction to a maximum of 0.002% of the recirculated water volume for counterflow towers and 0.005% of the recirculated water flow for cross-flow towers.
d. Building projects located in regions where the ambient mean coincident wet-bulb temperature at 1% design cooling conditions is greater than or equal to 72°F (22°C) shall have a system for collecting condensate from air-conditioning units with a capacity greater than 65,000 Btu/h (19 kW), and the condensate shall be recovered for reuse.

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 be prohibited.
c.The use of potable water or reclaimed water for irrigation of vegetated (green) roofs is prohibited after the vegetation establishment period or 18 month after the initial installation, whichever is less. After the landscape plants are established, the irrigation system using potable water or reclaimed water shall be removed from site.

Exception: Where approved by the AHJ, onsite treated reclaimed water may be used for vegetated roof irrigation systems during and after the vegetation establishment period.

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 be equipped with hands-free faucet controllers (foot controllers, sensor activated, or other) for all faucet fittings within the food preparation area of the kitchen and the dish room, including pot sinks and washing sinks.

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 (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. 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 multicell 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).

TABLE 601.3.4.1A (TABLE 6.3.4.1A)

WATER SUPPLY SOURCE MEASUREMENT THRESHOLDS

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

TABLE 601.3.4.1B (TABLE 6.3.4.1B)

SUBSYSTEM WATER MEASUREMENT THRESHOLDS

SUBSYSTEM	SUBMETERING THRESHOLD
Cooling towers (meter on makeup water and blowdown)	Cooling tower flow through tower > 500 gpm (30 L/s)
Evaporative coolers	Makeup water > 0.6 gpm (0.04 L/s)
Steam and hot-water boilers	> 500,000 Btu/h (150 kW) input
Total irrigated landscape area with controllers	> 25,000 ft2 (2500 m2)
Separate campus or project buildings	Consumption > 1000 gal/day (3800 L/day)
Separately leased or rental space	Consumption > 1000 gal/day (3800 L/day)
Any large water-using process	Consumption > 1000 gal/day (3800 L/day)

601.3.4.2 (6.3.4.2)Consumption Data Collection.

All building measurement devices, monitoring systems, and submeters installed to 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 capable of electronically storing water meter, monitoring systems, and submeter data and 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).

601.3.5 (6.3.5)Water Softeners.

Water softeners shall comply with Sections 601.3.5.1 (6.3.5.1) through 601.3.5.4 (6.3.5.4).

601.3.5.1 (6.3.5.1)Demand-Initiated Regeneration.

Water softeners shall be equipped with demand-initiated regeneration control systems. Timer-based control systems shall be prohibited.

601.3.5.2 (6.3.5.2)Water Consumption.

During regeneration, water softeners shall have a maximum water consumption of 4 gal (15.1 L) per 1000 grains (17.1 g/L) of hardness removed, as measured in accordance with NSF 44.

601.3.5.3 (6.3.5.3)Waste Connections.

Waste water from water softener regeneration shall not discharge to reclaimed water collection systems and shall discharge in accordance with the International Plumbing Code.

601.3.5.4 (6.3.5.4)Efficiency and Listing.

Water softeners that regenerate in place, that are connected to the water system they serve by piping not exceeding 11/4 in. (31.8 mm) in diameter, or that have a volume of 3 ft3 (0.085 m3) or more of cation exchange media shall have a rated salt efficiency of not less than 4000 grains of total hardness exchange per pound of salt (571 grams of total hardness exchange per kilogram of salt), based on sodium chloride equivalency, and shall be listed and labeled in accordance with NSF 44. All other water softeners shall have a

rated salt efficiency of not less than 3500 grains of total hardness exchange per pound of salt (500 grams of total hardness exchange per kilogram of salt), based on sodium chloride equivalency.

601.3.6 (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.

601.3.7 (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.

601.3.8 (6.3.8)Dual Water Supply Plumbing.

601.3.8.1 (6.3.8.1)

Where sufficient supply of reclaimed water or alternate on-site sources of water is available, 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.

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.

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CHAPTER7
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,” and either

a.Section 701.4 (7.4), “Prescriptive Option,” or
b.Section 701.5 (7.5), “Performance Option.”

701.3 (7.3)Mandatory Provisions.

701.3.1 (7.3.1)General.

Building projects shall be designed to comply with Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 of ANSI/ASHRAE/IES Standard 90.1.

701.3.1.1 (7.3.1.1)Continuous Air Barrier.

The exceptions to the requirement for a continuous air barrier in ANSI/ASHRAE/IES Standard 90.1, Section 5.4.3.1, for specific climate zones and constructions shall not apply. The testing criteria of Section 1001.3.1.5(a) [10.3.1.3.5(a)] shall supersede ANSI/ASHRAE/IES Standard 90.1, Section 5.4.3.1.3(a).

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 6.0 kBtu/ft2 (20 kWh/m2) for single-story buildings and not less than 10.0 kBtu/ft2(32 kWh/m2) multiplied by the gross roof area in feet squared (metres squared) for all other buildings.

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

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

TABLE 701.3.3.1B (TABLE 7.3.3.1B)

SYSTEM ENERGY USE THRESHOLDS

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

701.3.3.2 (7.3.3.2)Energy Consumption Data 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)Automated Demand Response.

Building projects shall contain automatic control systems that have the capability to reduce building equipment loads to lower electric peak demand of the building.

The building controls shall be designed with automated demand-response (DR) infrastructure capable of receiving DR requests from the utility, electrical system operator, or third-party DR program provider and automatically 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 automatically adjust upward the zone operating cooling set points by a minimum of 3°F (1.7°C).
b.The controls shall programmed to automatically adjust downward the zone operating heating set points by a minimum of 3°F (1.7°C).
c.The controls shall be programmed to automatically adjust downward the zone operating cooling set points by a minimum of 2°F (1.1°C).
d.The automated 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 automatic adjustment of the maximum speed of the

equipment to 90% of design speed during automated 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 automated 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 ANSI/ASHRAE/IES Standard 90.1. For all other criteria, the building project shall comply with the requirements of ANSI/ASHRAE/IES Standard 90.1.

701.4.1.1 (7.4.1.1)On-Site Renewable Energy Systems.

Building projects shall comply with either the Standard Renewables Approach in Section 701.4.1.1.1 (7.4.1.1.1) or the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2).

701.4.1.1.1 (7.4.1.1.1)Standard 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 6.0 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 10.0 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 Greene 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.

701.4.1.1.2 (7.4.1.1.2)Alternate Renewables Approach: Reduced On-Site Renewable Energy Systems and Higher-Efficiency Equipment.

Building projects complying with this approach shall comply with the applicable equipment efficiency requirements in Normative Appendix B, the water-heating efficiency requirements in Section 701.4.4.1 (7.4.4.1), equipment efficiency requirements in Section 701.4.7.1 (7.4.7.1), and the applicable ENERGY STAR® requirements in Section 701.4.7.3.2 (7.4.7.3.2), and shall contain on-site renewable energy systems that provide the annual energy production equivalent of not less than 4.0 kBtu/ft2 (13 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 (22 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. For equipment listed in Section 701.4.7.3.2 (7.4.7.3.2) that are also contained in Normative Appendix B, the installed equipment shall comply by meeting or exceeding both requirements.

Documentation shall be provided to the AHJ that indicates that the 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.

701.4.2 (7.4.2)Building Envelope.

The building envelope shall comply with ANSI/ASHRAE/IES Standard 90.1, Section 5, with the following modifications and additions.

701.4.2.1 (7.4.2.1)Building Envelope Requirements.

The building envelope shall comply with the requirements in ANSI/ASHRAE/IES Standard 90.1, Tables 5.5-0 through 5.5-8, with the following modifications to values in each table. For the opaque elements, each U-factor, C-factor, and F-factor in Tables 5.5-4 through 5.5-8 shall be reduced by 5%. The “Insulation Min. R-Value” column in ANSI/ASHRAE/IES Standard 90.1, Tables 5.5-4 through 5.5-8, shall not apply. For vertical fenestration and skylights, each U-factor shall be reduced by 5%. For skylights and east- and west-oriented vertical fenestration, each solar heat gain coefficient (SHGC) in Tables 5.5-0 through 5.5-8 shall be reduced by 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 ANSI/ASHRAE/IES Standard 90.1, Tables 5.5-4 through 5.5-8.
2.The SHGC shall not be modified where the SHGC requirement is designated as “NR” (no requirement) in ANSI/ASHRAE/IES Standard 90.1, Tables 5.5-0 through 5.5-8.
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.

Informative 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) of this code includes additional provisions related to roofs.

701.4.2.2 (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 ANSI/ASHRAE/IES Standard 90.1, Section A2.4.2.4. ANSI/ASHRAE/IES Standard 90.1, Section A2.4.2.4 and Table A2.4.2, shall not apply.

701.4.2.3 (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. ANSI/ASHRAE/IES Standard 90.1, Sections 5.5.3.6 and 5.5.4.3, shall not apply for high-speed doors complying with all criteria in this section.

701.4.2.4 (7.4.2.4) Air Curtains.

Where air curtains are provided at building entrances or building entrance vestibules, for the distance from the air-curtain discharge nozzle to the floor, the air-curtain unit shall produce a minimum velocity of 6.6 ft/s (2.0 m/s), in accordance with ANSI/AMCA 220, and be installed in accordance with manufacturer's instructions. Automatic controls shall be provided that will operate the air curtain with the opening and closing of the door. Air curtains and their controls shall comply with Section 1001.3.1.2.1 (10.3.1.2.1).

701.4.2.5 (7.4.2.5) Vertical Fenestration Area.

The total vertical fenestration area shall be less than 40% of the gross wall area. This requirement supersedes the requirement in ANSI/ASHRAE/IES Standard 90.1, Section 5.5.4.2.1.

701.4.2.6 (7.4.2.6) Permanent Projections.

For Climate Zones 0 through 3 and Climate Zones 4B and 4C, the vertical fenestration on the west, south, and east shall be shaded by permanent projections that have an area-weighted average projection factor (PF) of not less than 0.50 for the first story above grade and 0.25 for other above-grade stories. The building is allowed to be rotated up to 45 degrees to the nearest cardinal orientation for purposes of calculations and showing compliance. Where different windows or glass doors have different PF values, each shall be evaluated separately, or an area-weighted PF value shall be calculated and used for all windows and glass doors. Horizontal projections shall extend over the full width of the glazing.

Exceptions: Permanent projections are not required for the following buildings and fenestrations:

1.Where vertical fenestration is located within 18 in. (450 mm) of the lot line.
2.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.
3. Vertical fenestration with automatically controlled shading devices capable of modulating in multiple steps the amount of solar gain and light transmitted into the space in response to daylight levels or solar intensity that comply with all of the following:

a.Exterior shading devices shall be capable of providing at least 90% coverage of the fenestration in the closed position.
b.Interior shading devices shall be capable of providing at least 90% coverage of the fenestration in the closed position and have a minimum solar reflectance of 0.50 for the surface facing the fenestration.
c.A manual override located in the same enclosed space as the vertical fenestration shall override operation of automatic controls no longer than four hours.
d.Acceptance testing and commissioning shall be conducted as required by Chapter 10 (Section 10) to verify that automatic controls for shading devices respond to changes in illumination or radiation intensity.

4.Vertical fenestration with automatically controlled dynamic glazing capable of modulating in multiple steps the amount of solar gain and light transmitted into the space in response to daylight levels or solar intensity that comply with all of the following:

a.Dynamic glazing shall have a lower labeled SHGC equal to or less than 0.12, lowest labeled visible transmittance (VT) no greater than 0.05, and highest labeled VT no less than 0.40.
b.A manual override located in the same enclosed space as the vertical fenestration shall override operation of automatic controls no longer than 4 hours.
c.Acceptance testing and commissioning shall be conducted as required by Chapter 10 (Section 10) to verify that automatic controls for dynamic glazing respond to changes in illumination or radiation intensity.

5.Existing buildings undergoing alteration, repair, relocation, or a change of occupancy.

701.4.2.7 (7.4.2.7)SHGC of Vertical Fenestration.

For SHGC compliance, the methodology in ANSI/ASHRAE/IES Standard 90.1, Section 5.5.4.4.1, Exception 2, is allowed, provided that the SHGC multipliers in Table 701.4.2.7 (7.4.2.7) of this standard are used. This requirement supersedes the requirement in ANSI/ASHRAE/IES Standard 90.1, Table 5.5.4.4.1; that table shall not apply. Vertical fenestration that is north oriented shall be allowed to have a maximum SHGC of 0.10 greater than that specified in ANSI/ASHRAE/IES Standard 90.1, Tables 5.5-1 through 5.5-8. When this provision is used, separate calculations shall be performed for these sections of the building envelope, and these values shall not be averaged with any others for compliance purposes.

TABLE 701.4.2.7 (TABLE 7.4.2.7)

SHGC MULTIPLIERS FOR PERMANENT PROJECTIONS

PF	SHGC MULTIPLIER (ALL OTHERORIENTATIONS)	SHGC MULTIPLIER (NORTH-ORIENTED)
0 to 0.60	1.00	1.00
> 0.60 to 0.70	0.92	0.96
> 0.70 to 0.80	0.84	0.94
> 0.80 to 0.90	0.77	0.93
> 0.90 to 1.00	0.72	0.90

701.4.2.8 (7.4.2.8) Building Envelope Trade-Off Option.

The building envelope trade-off option in ANSI/ASHRAE/IES Standard 90.1, Section 5.6, shall not apply unless the procedure incorporates the modifications and additions to ANSI/ASHRAE/IES Standard 90.1 noted in Section 701.4.2 (7.4.2).

701.4.2.9 (7.4.2.9) Orientation.

The vertical fenestration shall comply with either (a) or (b):

where:

SHGCx = the SHGC for orientation x that complies with Section 701.4.2.7 (7.4.2.7).

SHGCC = the SHGC criteria for each climate zone from Section 701.4.2.1 (7.4.2.1).

Ax = fenestration area for orientation x.

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

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

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

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

Exceptions:

1.Vertical fenestration that complies with ANSI/ASHRAE/IES Standard 90.1, Section 5.5.4.4.1, Exception (3).
2.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).
3.Alterations and additions with no increase in vertical fenestration area.
4.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).
5.Buildings in Climate Zone 8.

701.4.3 (7.4.3)Heating, Ventilating, and Air Conditioning.

The heating, ventilating, and air conditioning shall comply with ANSI/ASHRAE/IES Standard 90.1, Section (6), with the following modifications and additions.

701.4.3.1 (7.4.3.1)Minimum Equipment Efficiencies for the Alternate Renewables Approach.

All building projects complying with the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2) 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:

a.Table 6.8.1.3, “Water-Chilling Packages—Minimum Efficiency Requirements.”

b.Table 6.8.1-11, “Air Conditioners and Condensing Units Serving Computer Rooms—Minimum Efficiency Requirements.”
c.Table 6.8.1-12, “Commercial Refrigerator and Freezers—Minimum Efficiency Requirements.”
d.Table 6.8.1-13, “Commercial Refrigeration— Minimum Efficiency Requirements.”
e.Table 6.8.1-14, “Vapor Compression Based Indoor Pool Dehumidifiers—Minimum Efficiency Requirements.”
f.Table 6.8.1-15, “Electrically Operated DXDOAS Units, Single-Package and Remote Condenser, without Energy Recovery—Minimum Efficiency Requirements.”
g.Table 6.8.1-16, “Electrically Operated DXDOAS Units, Single Package and Remote Condenser, with Energy Recovery—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)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:

$$FL_{adj} = FL/K_{adj}$$
$$PLV_{adj} = IPLV/K_{adj}$$
$$K_{adj} = A \times B$$

where:

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

FLadj = 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.

PLVadj = maximum NPLV rating, adjusted for nonstandard conditions.

A = 0.000000145920 × (LIFT)4 − 0.0000346496 × (LIFT)3 + 0.00314196 × (LIFT)2 − 0.147199 × (LIFT) + 3.93073.

B = 0.0015 × LvgEvap + 0.934.

LIFT = LvgCond − LvgEvap.

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

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

The FLadj and PLVadj values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

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

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

$$FL_{adj} = FL \times K_{adj}$$
$$PLV_{adj} = IPLV \times K_{adj}$$
$$K_{adj} = A \times B$$

where:

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

FL adj = minimum full-load COP rating, adjusted for nonstandard conditions.

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

PLV adj = minimum NPLV rating, adjusted for nonstandard conditions.

A = 0.00000153181 × (LIFT)4 − 0.000202076 × (LIFT)3 + 0.0101800 × (LIFT)2 − 0.264958 × LIFT + 3.93073.

B = 0.0027 × LvgEvap + 0.982.

LIFT = LvgCond − LvgEvap.

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

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

The FL adj and PLVadj 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 ANSI/ASHRAE/IES Standard 90.1, Section 6.4.3.8. 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 spaces.
4.Spaces with one of the following occupancy categories as listed in ANSI/ASHRAE Standard 62.1: cells in correctional facilities; daycare 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 ANSI/ASHRAE/IES Standard 90.1, Section 6.5.1, except as modified by the following:

a.The minimum size requirements for economizers for comfort cooling and for computer rooms are defined in Table 701.4.3.4 (7.4.3.4) and supersede the requirements in ANSI/ASHRAE/IES Standard 90.1, Tables 6.5.1-1 and 6.5.1-2.
b.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
c.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 the exceptions in ANSI/ASHRAE/IES Standard 90.1, Section 6.5.1, shall apply except as modified by the following:

a.Where the reduced renewable approach defined in Section 701.4.1.1.1 (7.4.1.1.1) is used, ANSI/ASHRAE/IES Standard 90.1, Section 6.5.1, Exception (9), shall be permitted to eliminate the economizer requirement, provided the requirements in ANSI/ASHRAE/IES Standard 90.1, Table 6.5.1-3, are applied to the efficiency requirements required by Section 701.4.1.1.2 (7.4.1.1.2). If the standard renewable approach is chosen as defined in Section 701.4.1.1.1 (7.4.1.1.1) then the requirements in ANSI/ASHRAE/IES Standard 90.1, Table 6.5.1-3, shall be applied to the efficiency requirements in ANSI/ASHRAE/IES Standard 90.1, Tables 6.8.1-1 through 6.8.1-11.
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 condenserwater 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) condenserwater supply temperature.

TABLE 701.4.3.4 (TABLE 7.4.3.4)

MINIMUM SYSTEM SIZE FOR WHICH AN ECONOMIZER IS REQUIRED

CLIMATE ZONES	COOLING CAPACITY FOR WHICH AN ECONOMIZER IS REQUIREDa
0A, 0B, 1A, 1B	No economizer requirement
2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	≥ 33,000 Btu/h (9.7 kW)a

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

701.4.3.5 (7.4.3.5) Zone Controls.

The exceptions to ANSI/ASHRAE/IES Standard 90.1, Section (6.5.2.1), shall be modified as follows:

a.Exception (1) shall not be used.
b.Exception (2)(a)(2) shall be replaced by the following text: “the design outdoor airflow rate for the zone.”

701.4.3.6 (7.4.3.6)Fan System Power and Efficiency.

701.4.3.6.1 (7.4.3.6.1) Fan System Power Limitation.

Systems shall have fan power limitations 10% below limitations specified in ANSI/ASHRAE/IES Standard 90.1, Table 6.5.3.1-1. This requirement supersedes the requirement in ANSI/ASHRAE/IES Standard 90.1, Section (6.5.3.1) and Table (6.5.3.1- 1). All exceptions in ANSI/ASHRAE/IES Standard 90.1, Section 6.5.3.1, shall apply.

701.4.3.6.2 (7.4.3.6.2) Fan Efficiency.

The fan efficiency requirements defined in ANSI/ASHRAE/IES Standard 90.1, Section 6.5.3.1.3, 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 ANSI/ASHRAE/IES Standard 90.1, Section 6.5.3.1.3, shall apply.

701.4.3.7 (7.4.3.7)Exhaust Air Energy Recovery.

The exhaust air energy recovery requirements defined in ANSI/ASHRAE/IES Standard 90.1, Section 6.5.6.1, including the requirements in Tables 6.5.6.1-1 and 6.5.6.1-2, shall be used except that the energy recovery effectiveness shall not be less than 60%, superseding the 50% effectiveness requirement in ANSI/ASHRAE/IES Standard 90.1, Section 6.5.6.1.

701.4.3.8 (7.4.3.8)Kitchen Exhaust Systems.

The requirements in ANSI/ASHRAE/IES Standard 90.1, Section 6.5.7.2 shall apply, except as follows: Sections 701.4.3.8.1 (7.4.3.8.1) and 701.4.3.8.2 (7.4.3.8.2) supersede the requirements in ANSI/ASHRAE/IES Standard 90.1, Sections 6.5.7.2.2 and 6.5.7.2.3.

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.

TABLE 701.4.3.8.1 (TABLE 7.4.3.8.1)

MAXIMUM NET EXHAUST FLOW RATE PER LENGTH OF HOOD

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

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

701.4.3.8.2 (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.In Climate Zones 0B, 1B, 2B, 3B, 4B, 5B, 6B, 7B, and 8B, 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 Normative Appendix A, Tables A-2 and A-3. These requirements supersede the requirements in ANSI/ASHRAE/IES Standard 90.1, Table 6.8.2.

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 controls for the lighting, switched outlets, television, and HVAC equipment serving each guest room shall be configured according to the following requirements.

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 unoccupied 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 preoccupancy 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 ANSI/ASHRAE/IES Standard 90.1, Section 7, with the following modifications and additions.

701.4.4.1 (7.4.4.1)Equipment Efficiency for the Alternate Renewables Approach.

All building projects complying with the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2) shall comply with the applicable equipment efficiency requirements 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 ANSI/ASHRAE/IES Standard 90.1, Table 7.8.

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).

701.4.5 (7.4.5)Power.

The power shall comply with ANSI/ASHRAE/IES Standard 90.1, Section 8.

701.4.6 (7.4.6)Lighting.

The lighting shall comply with ANSI/ASHRAE/IES Standard 90.1, Section 9, with the following modifications and additions.

701.4.6.1 (7.4.6.1)Lighting Power Allowance

TABLE 701.4.6.1A (TABLE 7.4.6.1A)

LIGHTING POWER DENSITIES USING THE BUILDING AREA METHOD

BUILDING AREA TYPEa	LPD, W/ft2	LPD, W/m2
Automotive facility	0.64	6.9
Convention center	0.51	5.5
Courthouse	0.74	8.0
Dining: Bar lounge/leisure	0.69	7.4
Dining: Cafeteria/fast food	0.66	7.1
Dining: Family	0.61	6.6
Dormitory	0.52	5.6
Exercise center	0.61	6.6
Fire station	0.50	5.4
Gymnasium	0.67	7.2
Health care clinic	0.68	7.3
Hospital	0.86	9.3
Hotel/Motel	0.70	7.5
Library	0.72	7.8
Manufacturing facility	0.60	6.5
Motion picture theater	0.62	6.7
Multifamily	0.49	5.3
Museum	0.68	7.3
Office	0.69	7.4
Parking garage	0.12	1.3
Penitentiary	0.67	7.2
Performing arts theater	0.85	9.1
Police station	0.68	7.3
Post office	0.62	6.7
Religious facility	0.70	7.5
Retail	0.91	9.8
School/university	0.67	7.2
Sports arena	0.76	8.2
Town hall	0.72	7.8
Transportation	0.51	5.5
Warehouse	0.41	4.4
Workshop	0.83	8.9

a. In cases where both a general building area type and a specific building area type are listed, the specific building area type shall apply.

TABLE 701.4.6.1B (TABLE 7.4.6.1B)

LIGHTING POWER DENSITY (LPD) ALLOWANCES AND ROOM CAVITY RATIO (RCR) THRESHOLDS USING THE SPACE-BY-SPACE METHOD

Informative Note: This table is divided into two sections. The first section covers space types that can be commonly found in multiple-building types. The second part covers space types that are typically found in a single-building type.

COMMON SPACE TYPES a	LPD, W/ft2	LPD, W/m2	RCR THRESHOLD
Atrium			
< 20 ft (6.1 m) in height	0.023/ft total height	0.81/m total height	NA
≥ 20 ft (6.1m) and ≤ 40 ft (12.2 m) in height	0.023/ft total height	0.81/m total height	NA
> 40 ft (12.2 m) in height	0.30 + 0.015/ft total height	3.2 + 0.53/m total height	NA
Audience Seating Area			
Auditorium	0.67	7.2	6
Convention center	0.65	7.0	4
Gymnasium	0.43	4.6	6
Motion picture theater	0.64	6.9	4
Penitentiary	0.44	4.7	4
Performing arts theater	1.34	14.4	8
Religious building	0.98	10.5	4
Sports arena	0.42	4.5	4
All other audience seating areas	0.40	4.3	4
Banking Activity Area	0.79	8.5	6
Breakroom (see Lounge/Breakroom)			
Classroom/Lecture Hall/Training Room			
Penitentiary	1.06	11.4	4
All other classrooms/lecture halls/training rooms	0.74	8.0	4
Conference/Meeting/Multipurpose Room	0.93	10.0	6
Confinement Cells	0.52	5.6	6
Copy/Print Room	0.50	5.4	6
Corridor b			
Facility for the visually impaired (and not used primarily by the staff) c	0.81	8.7	width < 8 ft (2.4 m)
Hospital	0.81	8.7	width < 8 ft (2.4 m)

Manufacturing facility	0.28	3.0	width < 8 ft (2.4 m)
All other corridors	0.58	6.2	width < 8 ft (2.4 m)
Courtroom	0.98	10.5	6
Computer Room	1.16	12.5	4
Dining Area			
Penitentiary	0.72	7.8	6
Facility for the visually impaired (and not used primarily bystaff) c	1.48	15.9	4
Bar/lounge or leisure dining	0.62	6.7	4
Cafeteria or fast food dining	0.53	5.7	4
Family dining	0.54	5.8	4
All other dining areas	0.53	5.7	4
Electrical/Mechanical Room g	0.39	4.2	6
Emergency Vehicle Garage	0.53	5.7	4
Food Preparation Area	0.92	9.9	6
Guest Room	0.75	8.1	6
Laboratory			
In or as a classroom	1.04	11.2	6
All other laboratories	1.24	13.3	6
Laundry/Washing Area	0.43	4.6	4
Loading Dock, Interior	0.51	5.5	6
Lobby			
Facility for the visually impaired(and not used primarily by the staff) c	1.30	14.0	4
Elevator	0.52	5.6	6
Hotel	0.68	7.3	4
Motion picture theater	0.38	4.1	4
Performing arts theater	0.82	8.8	6
All other lobbies	0.86	9.3	4
Locker Room	0.45	4.8	6
Lounge/Breakroom			
Healthcare facility	0.53	5.7	6
All other lounges/breakrooms	0.44	4.7	4
Office			
Enclosed and ≤ 250 ft2 (23 m2)	0.85	9.1	8
Enclosed and > 250 ft2 (23 m2)	0.85	9.1	8
Open plan	0.78	8.4	4
Parking Area, Interior	0.11	1.2	4
Pharmacy Area	1.23	13.2	6
Restroom			
Facility for the visually impaired(and not used primarily by the staff) c	0.81	8.7	8
All other restrooms	0.75	8.1	8
Sales Area d	1.06	11.4	6

Seating Area, General	0.38	4.1	4
Stairway	The space containing the stairway shall determine the LPD requirements for the stairway.		
Stairwell	0.50	5.4	10
Storage Room			
< 50 ft2 (4.6m2)	0.86	9.3	6
⩾ 50 ft2 (4.6m2) and ⩽ 1000 ft2 (93 m2)	0.43	4.6	6
All other storage rooms	0.43	4.6	6
Vehicular Maintenance Area	0.53	5.7	4
Workshop	1.09	11.7	6
BUILDING TYPE SPECIFIC SPACE TYPES a	LPD, W/ft2	LPD, W/m2	RCR THRESHOLD
Facility for the Visually Impaired c			
Chapel (used primarily by residents)	0.89	8.9	4
Recreation room/common living room(and not used primarily by staff)	1.53	15.3	6
Automotive (see Vehicular Maintenance Area)			
Convention Center—Exhibit Space	0.69	7.43	4
Dormitory—Living Quarters	0.46	4.95	8
Fire Station—Sleeping Quarters	0.19	2.05	6
Gymnasium/Fitness Center			
Exercise area	0.50	5.4	4
Playing area	0.75	8.1	4
Healthcare Facility			
Exam/treatment room	1.16	12.5	8
Imaging room	0.98	10.5	6
Medical supply room	0.54	5.8	6
Nursery	0.94	10.1	6
Nurse’s station	0.75	8.1	6
Operating room	1.87	20.1	6
Patient room	0.45	4.8	6
Physical therapy room	0.85	9.1	6
Recovery room	0.89	9.6	6
Library			
Reading area	0.77	8.3	4
Stacks	1.08	11.6	4
Manufacturing Facility			
Detailed manufacturing area	0.86	9.3	4
Equipment room	0.61	6.6	6
Extra high bay area (> 50 ft [15.2 m] floor-to-ceiling height)	0.73	7.9	4
High bay area (25 ft [7.6 m] to 50 ft [15.2 m] floor-to-ceiling height)	0.58	6.2	4
Low bay area (< 25 ft [7.6 m] floor-	0.61	6.6	4

to-ceiling height)			
Museum			
General exhibition area	0.61	6.6	6
Restoration room	0.77	8.3	6
Performing Arts Theater—Dressing Room	0.35	3.8	6
Post Office—Sorting Area	0.66	7.1	4
Religious Buildings			
Fellowship hall	0.42	4.5	4
Worship/pulpit/choir area	0.98	10.5	4
Retail Facilities			
Dressing/fitting room	0.49	5.3	8
Mall concourse	0.79	8.5	4
Sports Arena—Playing Areah			
Class I facility	2.26	24.3	4
Class II facility	1.45	15.6	4
Class III facility	1.08	11.6	4
Class IV facility	0.72	7.8	4
Transportation Facility			
Baggage/carousel area	0.40	4.3	4
Airport concourse	0.22	2.4	4
Terminal ticket counter	0.48	5.2	4
Warehouse—Storage Area			
Medium-to-bulky, palletized items	0.27	2.9	4
Smaller, hand-carried itemse	0.65	7.0	6

a.In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply.
b.In corridors, the extra LPD allowance is permitted when the width of the corridor is less than 8 ft (2.4 m) and is not based on the RCR, see Section 701.4.6.1.1(c) [7.4.6.1.1(c)].
c.A “Facility for the visually impaired” is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support, and/or people with special visual needs.
d.For accent lighting, see Section 701.4.6.1.1(d) [7.4.6.1.1(d)].
e.Sometimes referred to as a “picking area.”
f.Not used to keep footnote numbering consistent with ANSI/ASHRAE/IES Standard 90.1.
g.Electrical/mechanical rooms. An additional 0.50 W/ft2 (5.4 W/m2) shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.39 W/ft2 (4.2 W/m2). The additional 0.50 W/ft2 (5.4 W/m2) allowance shall not be used for any other purpose.
h.Class of play as defined by IES RP-6.

701.4.6.1.1 (7.4.6.1.1)Interior Lighting Power Densities (LPDs).

The interior lighting power allowance shall be determined using ANSI/ASHRAE/IES Standard 90.1, either Section 9.5 or 9.6, with the following

modifications:

a.For those areas where the Building Area Method is used, the LPD from ANSI/ASHRAE/IES Standard 90.1, Table 9.5.1, shall be replaced with the corresponding LPD in Table 701.4.6.1A (7.4.6.1A).
b.For those areas where the Space-by-Space Method is used, the LPD from ANSI/ASHRAE/IES Standard 90.1, Table 9.6.1, shall be replaced with the corresponding LPD in Table 701.4.6.1B (7.4.6.1B).
c.Room geometry adjustment when using the Space-by-Space Method: ANSI/ASHRAE/IES Standard 90.1, Section 9.6.4, shall be replaced with the following. For corridor/transition spaces less than 8 ft (2.4 m) wide, or individual spaces where room cavity ratio (RCR) calculated for the empty room is documented to be greater than the RCR threshold for that space type shown in Table 701.4.6.1B (7.4.6.1B), the allowed LPD shall be 1.2 times the LPD in Table 701.4.6.1B (7.4.6.1B). RCR shall be calculated as described in ANSI/ASHRAE/IES Standard 90.1, Section 9.6.4.
d.Additional lighting power when using the Space-by-Space Method: For those areas where the Space-by-Space Method is used, the additional increase in the interior lighting power allowed by ANSI/ASHRAE/IES Standard 90.1, Section 9.6.2, for specific lighting functions shall be replaced by the requirements and allowances of this section. Additional power shall be allowed only if the specified lighting is installed and automatically controlled separately from the general lighting and is designed and installed to be turned off during nonbusiness hours. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose. An increase in the interior lighting power allowance is permitted in the following cases:

1.For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 0.5W/ft2 (5.4 W/m2) of such spaces.
2.For lighting equipment installed in sales areas and specifically designed and directed to highlight merchandise, calculate the additional lighting power as follows:

Additional interior *lighting power allowance* =
750 W
+ [Retail Area 1 × 0.40 W/ft^2 (4.3 W/m^2)]
+ [Retail Area 2 × 0.40 W/ft^2 (4.3 W/m^2)]
+ [Retail Area 3 × 1.00 W/ft^2 (10.8 W/m^2)]
+ [Retail Area 4 × 1.50 W/ft^2 (16.1 W/m^2)]

where:

Retail Area 1 = the floor area for all products not listed in Retail Areas 2, 3, or 4.

Retail Area 2 = the floor area used for the sale of vehicles, sporting goods, and small electronics.

Retail Area 3 = the floor area used for the sale of furniture, clothing, cosmetics, and artwork.

Retail Area 4 = the floor area used for the sale of jewelry, crystal, and china.

Exception: Other merchandise categories included in Retail Areas 2 through 4 where the authority having jurisdiction has approved the documented need for additional lighting power based on visual inspection, contrast, or other critical display.

e.Any of the control factors from ANSI/ASHRAE/IES Standard 90.1, Table 9.6.3, shall be permitted to be applied, provided that the corresponding control method is not required by ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1.
f.An additional lighting power allowance shall be credited for institutional tuning of dimmable lighting systems that meet all of the following requirements:

1.Institutional tuning controls shall be accessible only to authorized personnel.
2.Construction documents shall state that maximum light output or power of controlled lighting shall be reduced by at least 15% from full output.
3.The maximum light output or power of the controlled lighting shall be measured without institutional tuning and with institutional tuning to verify reduction of light output or power by at least 15% when tuned. In daylighted areas these measurements shall be conducted at night.

For controlled lighting in daylighted areas, the additional lighting power allowance shall be 0.05 times the controlled lighting power. In nondaylighted areas, the additional lighting power allowance shall be 0.10 times the controlled lighting power.

701.4.6.1.2 (7.4.6.1.2)Exterior LPDs.

The exterior lighting power allowance shall be determined using ANSI/ASHRAE/IES Standard 90.1, Section 9.4.3, with the following modification. The LPDs from ANSI/ASHRAE/IES Standard 90.1, Table 9.4.2-2, shall be multiplied by the appropriate LPD factor from Table 701.4.6.1.2 (7.4.6.1.2).

TABLE 701.4.6.1.2 (TABLE 7.4.6.1.2)

LIGHTING POWER ALLOWANCE FACTORS

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

701.4.6.2 (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 highintensity discharge (HID) lighting with an LPD of 0.8 W/ft2 (8.6 W/m2) or less.

701.4.6.3 (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.

701.4.6.4 (7.4.6.4)Controls for Exterior Sign Lighting.

This section supersedes ANSI/ASHRAE/IES Standard 90.1, Section 9.4.1.4, for all 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 ANSI/ASHRAE/IES Standard 90.1, Section 9.4.1.4, 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 controlled zone for a period no longer than 15 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 ANSI/ASHRAE/IES Standard 90.1, Section 10, with the following modifications and additions.

701.4.7.1 (7.4.7.1)Equipment Efficiency for the Alternate Renewables Approach.

All building projects complying with the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2) 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 all building projects complying with the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2) shall also comply with Section 701.4.7.3.2 (7.4.7.3.2).

701.4.7.3.1 (7.4.7.3.1)ENERGY STAR Requirements for Equipment not Covered by Federal Appliance Efficiency Regulations (All Building Projects).

The following equipment within the scope of the applicable ENERGY STAR program shall comply with the equivalent criteria required to achieve the ENERGY STAR label if installed prior to the issuance of the certificate of occupancy:

a.Appliances:

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

b.Heating and Cooling:

1.Programmable thermostats: ENERGY STAR Program Requirements for Programmable Thermostats.
2.Ventilating fans: ENERGY STAR Program Requirements for Residential Ventilating Fans.

c.Electronics:

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

d.Office Equipment:

1.Computers: ENERGY STAR Program Requirements for Computers.
2.Copiers: ENERGY STAR Program Requirements for Imaging Equipment.
3.Fax machines: ENERGY STAR Program Requirements for Imaging Equipment.
4.Laptops: ENERGY STAR Program Requirements for Computers.
5.Mailing machines: ENERGY STAR Program Requirements for Imaging Equipment.
6.Monitors: ENERGY STAR Program Requirements for Displays.

7.Multifunction devices (printer/fax/scanner): Program Requirements for Imaging Equipment.
8.Printers: ENERGY STAR Program Requirements for Imaging Equipment.
9.Scanners: ENERGY STAR Program Requirements for Imaging Equipment.
10.Computer servers: ENERGY Star Program Requirements for Computer Servers.

e.Lighting:

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

f.Commercial Food Service:

1.Commercial fryers: ENERGY STAR Program Requirements for Commercial Fryers.
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)].
4.Commercial dishwashers: ENERGY STAR Program Requirements for Commercial Dishwashers.
5.Commercial griddles: ENERGY STAR Program Requirements for Commercial Griddles.
6.Commercial ovens: ENERGY STAR Program Requirements for Commercial Ovens [see also water efficiency requirements in Section 601.3.2.5 (6.3.2.5)].

Exception: Products with minimum efficiencies addressed in the Energy Policy Act (EPAct) and the Energy Independence and Security Act (EISA) when complying with Section 701.4.1.1.2 (7.4.1.1.2).

701.4.7.3.2 (7.4.7.3.2)ENERGY STAR Requirements for Equipment Covered by Federal Appliance Efficiency Regulations (Alternate Renewables Approach). For all building projects complying with the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2), 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. 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 [see also the water efficiency requirements in Section 601.3.2.2 (6.3.2.2)].
2.Dehumidifiers: ENERGY STAR Program Requirements for Dehumidifiers.
3.Dishwashers: ENERGY STAR Program Requirements Product Specifications for Residential Dishwashers [see also the water efficiency requirements in Section 601.3.2.2 (6.3.2.2)].
4.Refrigerators and freezers: ENERGY STAR Program Requirements for Refrigerators and Freezers.
5.Room air conditioners: ENERGY STAR Program Requirements and Criteria for Room Air Conditioners.

b.Heating and Cooling:

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

c.Water Heaters: ENERGY STAR Program Requirements for Residential Water Heaters.
d.Lighting:

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

e.Commercial Food Service:

1.Commercial refrigerators and freezers: ENERGY STAR Program Requirements for Commercial Refrigerators and Freezers.
2.Commercial ice machines: ENERGY STAR Program Requirements for Commercial Ice Machines.

f.Other Products:

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

701.4.7.4 (7.4.7.4)Programmable Thermostats.

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.

701.4.8 (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.

701.5.1 (7.5.1)Annual Energy Cost.

The proposed building performance cost index with consideration of renewables shall be calculated in accordance with ANSI/ASHRAE/IES Standard 90.1, Normative Appendix G, and be equal to or less than the Performance Cost Index (PCI) Target, as determined from the following equation:

$$PCI_{target} = \frac{BBUEC + (BBREC \times BPF) - REC}{BBUEC + BBREC}$$

where:

PCItarget = target PCI required for achieving compliance with the standard, unitless.

BBUEC = the component of baseline building performance that is due to unregulated energy use, $.

BBREC = the component of baseline building performance that is due to regulated energy use, or baseline building performance minus BBUEC, $.

BPF = building performance factor taken from Table 701.5.2A (7.5.2A), unitless.

REC = renewable energy production determined from Section 701.4.1.1.1 (7.4.1.1.1) and converted to cost, $.

The proposed building PCI, without consideration of renewables, shall comply with the requirements of ANSI/ASHRAE/IES Standard 90.1, Section 4.2.1.1.

On-site renewable energy systems in the proposed design shall be calculated using the procedures in Normative Appendix C. For mixed-use buildings, the building performance factor (BPF) shall be determined by weighting each building type by floor area.

701.5.2 (7.5.2)Annual Carbon Dioxide Equivalent (CO2e).

The proposed design shall have an annual CO2e equal to or less than the annual CO2e of the baseline building design multiplied by the building performance factor (BPF) target determined from Table 701.5.2A (7.5.2A) using the Performance Rating Method in ANSI/ASHRAE/IES Standard 90.1, Normative Appendix G. To determine the annual CO2e for each energy source in the baseline building design and proposed design, the energy consumption shall be multiplied by the CO2e emission factors from Table 701.5.2B (7.5.2B).

TABLE 701.5.2A (TABLE 7.5.2A)

ENERGY COST AND CO2e BUILDING PERFORMANCE FACTORS (BPF)

BUILDING TYPE	BUILDING PERFORMANCE FACTOR (BPF)

Multifamily	0.71
Healthcare/hospital	0.56
Hotel/motel	0.58
Office	0.54
Restaurant	0.59
Retail	0.50
School	0.37
Semiheated warehousea	0.44
All others	0.54

a. Conditioned warehouses shall use the “All others” category.

TABLE 701.5.2B (TABLE 7.5.2B)

CO2e EMISSION FACTORS

BUILDING PROJECT ENERGY SOURCE	CO2e, lb/MWh	CO2e, kg/MWh
Grid-delivered electricity and other fuels not specified in this table	1348	612
LPG or propane	601	273
Fuel oil (residual)	685	311
Fuel oil (distillate)	663	301
Coal	820	372
Gasoline	681	309
Natural gas	509	231
District chilled water	323	146
District steam	855	388
District hot water	807	366

The values in this table represent national averages for the United States and include both direct and indirect emissions.

- **Collaborate and notate** questions and comments between colleagues and share externally with easy cut and paste.

08_CHAPTER 8 INDOOR ENVIRONMENTAL QUALITY (IEQ) | 2018 2018 International Green Construction Code® (IgCC®) | ICC premiumACCESS

2018 2018 International Green Construction Code® (IgCC®)

(First Printing: Sep 2018)

CHAPTER8 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,” 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 ASHRAE Standard 62.1, ASHRAE Standard 62.2, and ASHRAE/ASHE Standard 170.

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, ASHRAE Standard 62.1, Sections 6.1.1 and 6.2, shall be used to determine minimum zone and intake outdoor airflow rates. ASHRAE Standard 62.1, Sections 6.1.2 and 6.1.3, shall not apply.

Informative Note: ASHRAE Standard 62.1, Sections 6.1.1 and 6.2, define the Ventilation Rate Procedure for determining ventilation 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.

801.3.1.4.2 (8.3.1.4.2)Exfiltration.

Mechanical airconditioning systems with dehumidification capability shall include system controls capable of maintaining static pressure inside the building, at the top floor, equal to or greater than the static pressure outside of the building during mechanical cooling operation.

Exceptions:

1.Where excess exhaust is required by process considerations, such as certain industrial or healthcare facilities.
2.Warehouse facilities.
3.Buildings in Climate Zones 0B, 1B, 2B, 3B, 3C, 4B, 4C, 5, 6, 7 and 8.

801.3.1.5 (8.3.1.5)Venting of Combustion Products.

801.3.1.5.1 (8.3.1.5.1)Vented Combustion.

Permanently installed appliances shall have products of combustion vented to the outdoors.

Exceptions:

1.Ovens and ranges in residential spaces.
2.Heaters certified to ANSI Z83.19/CSA 2.35, mounted greater than or equal to 10 ft (3 m) above the occupied floor.
3.Heaters certified to ANSI Z83.4/CAN 3.7.
4.Heaters certified to ANSI Z21.11.2, provided that the aggregate input rating of all such appliances does not exceed 1000 Btu/h per 1500 ft3 (700 W per 100 m3) of space volume.

801.3.1.5.2 (8.3.1.5.2)Ranges in Residential Spaces.

Gas and electric ranges in residential spaces shall comply with ASHRAE Standard 62.2, Section 5.1, using a range hood.

801.3.1.6 (8.3.1.6)Humidity Control.

The requirements in this section supersede the requirements in ASHRAE Standard 62.1, Section 5.9.1. Mechanical airconditioning 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)Cooling Coils.

HVAC systems with dehumidification capability in Climate Zones 0A, 1A, 2A, 3A, 4A, and 4C shall be designed in accordance with one of the following:

a.Where recirculating systems do not include means for HVAC zone humidity sensing, such systems shall include controls capable of maintaining the average cooling-coil leaving air temperature at 53°F (12°C) or lower and shall include devices and controls capable of maintaining each HVAC zone sensible temperature set point using one of the following approaches:

1.Variable HVAC zone supply airflow rate.
2.Variable return-air bypass flow around each cooling coil serving one or more HVAC zones.
3.Variable HVAC zone supply air reheat using site-recovered energy or site solar energy.

b.Where a 100% outdoor air system provides preconditioned outdoor air for ventilation, and where such systems do not include means for HVAC zone humidity sensing, the 100% outdoor air system shall include devices and controls capable of maintaining the average cooling-coil leaving air temperature at 53°F (12°C) or lower.
c. Where systems include means for HVAC zone relative humidity sensing, such systems shall include devices and controls capable of limiting HVAC zone relative humidity to not exceed 65% rh for more than 48 consecutive hours.

801.3.1.6.2 (8.3.1.6.2)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.

801.3.1.7 (8.3.1.7)Environmental Tobacco Smoke

a.Smoking shall not be allowed inside the building. Signage stating such shall be posted within 10 ft (3 m) of each building entrance.
b.Any exterior designated smoking areas shall be located a minimum of 25 ft (7.5 m) away from building entrances, outdoor air intakes, and operable windows.

801.3.1.8 (8.3.1.8)Building Entrances.

All building entrances shall employ an entryway floor system comprising a scraper surface, an absorption surface, and a finishing surface, in that order, in the direction of travel entering the building and in accordance with Sections 801.3.1.8.1, 801.3.1.8.2, and 801.3.1.8.3 (8.3.1.8.1, 8.3.1.8.2, and 8.3.1.8.3). Each surface shall be at least as wide as the entrance. The length shall be measured in the primary direction of travel.

Exceptions:

1.Entrances to individual dwelling units.
2.Entrances that employ an entryway floor system that is not less than 4 ft (1.3 m) in length to provide access to spaces that are less than 3000 ft2 (300 m2) in area and that are not used as a pass-through to other parts of the building.
3.Doors the purpose of which is to meet code requirements (Informative Note: e.g., International Building Code) for means of egress and not entry into the building.
4.Entrances that are locked for use by limited authorized personnel.

801.3.1.8.1 (8.3.1.8.1)Scraper Surface.

The scraper surface shall be:

a.immediately outside, inside, or spanning the entry;
b.a minimum of 3 ft (1 m) long; and
c.constructed using materials that scrape away snow, dirt, and debris.

801.3.1.8.2 (8.3.1.8.2)Absorption Surface.

The absorption surface shall be:

a.inside,
b.a minimum of 3 ft (1 m) long, and
c.constructed using materials that perform both a scraping action and a moisture wicking action.

801.3.1.8.3 (8.3.1.8.3) Finishing Surface.

The finishing surface shall be:

a.a minimum of 4 ft (1.2 m) long and
b.constructed using materials that capture particles and moisture.

801.3.1.9 (8.3.1.9) Guest Room Preoccupancy Outdoor Air Purge Cycle.

Guest room ventilation systems controlled according to Section 701.4.3.9.4 (7.4.3.9.4) shall have an automatic preoccupancy purge cycle that shall provide outdoor air ventilation at the design ventilation rate for 60 minutes, or at a rate and duration equivalent to one air change. In guest rooms with a networked guest room control system, the purge cycle shall be completed within 60 minutes prior to the time the room is scheduled to be occupied. Where guest rooms are not connected to a networked guest room control system, the preoccupancy purge cycle shall occur daily.

801.3.1.10 (8.3.1.10) Preoccupancy Ventilation Control.

Ventilation systems serving zones that are not continuously occupied shall have controls designed to automatically provide outdoor air to the zones, prior to their scheduled occupancy, where the zones served by the ventilation system have been unoccupied for 24 hours or longer. This preoccupancy ventilation shall be provided continuously at the system design minimum outdoor airflow for a period of one hour prior to the expected occupancy, or at an outdoor air rate and for a time period that provides the same number of air changes as the design minimum outdoor airflow for one hour.

If the preoccupancy ventilation period requires ventilation earlier than as required by ANSI/ASHRAE/IES Standard 90.1, Section 6.4.3, the preoccupancy ventilation start time of Section 801.3.1.7 (8.3.1.7) shall take precedence.

Exception: Hotel and motel guest rooms subject to automatic control of HVAC and lighting as required in Chapters 7 and 8 (Sections 7 and 8).

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 (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. All other spaces shall be designed in accordance with Sections 801.3.3.1 (8.3.3.1) through 801.3.3.5 (8.3.3.5).

801.3.3.1 (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.

801.3.3.1.1 (8.3.3.1.1)Test Methods.

The laboratory tested performance for sound transmission class (STC) for wall, partition, window, and ceiling/floor assemblies shall be tested in accordance with ASTM E90, and the laboratory tested performance for impact insulation class (IIC) for floor/ceiling assemblies shall be tested in accordance with ASTM E492. All assemblies shall be sealed according to ASTM C919 and in accordance with the laboratory tested assembly details and materials. Field tested assemblies used in the analysis shall be tested in accordance with ASTM E336 and ASTM E1007.

801.3.3.2 (8.3.3.2)Interior Background Noise Requirements.

The building envelope; interior spaces within the building; and building systems, including mechanical, electrical, and plumbing systems, shall be designed and constructed such that the interior sound pressure levels created by the combination of building systems noise and exterior sound sources, under normal operation with windows closed and no active sound masking systems, do not exceed the values specified in Table 801.3.3.2 (8.3.3.2). The hourly average sound pressure level Leq and maximum sound pressure level Lmax shall not exceed the values listed in Table 801.3.3.2 (8.3.3.2). Outdoor noise levels used in the design shall be provided in the construction documents.

TABLE 801.3.3.2 (TABLE 8.3.3.2)

MAXIMUM INTERIOR BACKGROUND SOUND PRESSURE LEVELS FROM BUILDING SYSTEMS AND EXTERIOR SOUND SOURCES a

	HOURLY AVERAGE SOUNDPRESSURE LEVEL (Leq)		MAXIMUM SOUND PRESSURE LEVEL (Lmax[slow time weighting])	
ROOM TYPE	dBA	dBC	dBA	dBC
Residential sleeping areas (nighttimeb)	35	60	45	70
Residential living and sleeping areas (daytime)	40	60	50	70
Hotel and motel guest rooms or suites and dormitories	40	60	50	70
Meeting and banquet rooms	35	60	45	70
Corridors and lobbies	45	65	60	75
Service and support areas	45	65	60	75
Enclosed offices	35	60	45	70
Conference rooms	35	60	45	70
Teleconference rooms	30	55	40	65
Open-plan offices	45	65	55	75
Courtrooms—unamplified speech	35	60	45	70
Courtrooms—amplified speech	40	60	50	70
Laboratories—minimal speech communication	55	75	65	85
Laboratories—extensive phone use and speech communication	50	70	60	80
Laboratories—group teaching	40	60	50	70
Religious—general assembly with music program	30	55	40	65
Library study and	35	60	45	70

reading areas				
Gymnasiums and natatoriums without speech amplification	50	70	60	80
Gymnasiums and natatoriums with speech amplification	55	75	65	85

a.For high-noise exterior events, refer to Section 801.3.3.2.1 (8.3.3.2.1).
b.“Nighttime” is defined as the time between 10 p.m. and 7 a.m.

801.3.3.2.1 (8.3.3.2.1)High-Noise Exterior Events.

Hourly average sound pressure levels Leq shall be permitted to exceed the values specified in Table 801.3.3.2 (8.3.3.2) by not more than 5 dB where the excess sound pressure is attributed to high-noise exterior events that occur more than ten times per day, and by not more than 10 dB where the excess sound pressure is attributed to high-noise exterior events that occur ten times or fewer per day. Maximum sound pressure levels Lmax shall be permitted to exceed the values specified in Table 801.3.3.2 (8.3.3.2) by not more than 10 dB where the excess sound pressure is attributed to high-noise exterior events that occur more than ten times per day. Maximum sound pressure levels Lmax shall be permitted to exceed the values specified in Table 801.3.3.2 (8.3.3.2), without limitation, where the excess sound pressure is attributed to high-noise exterior events that occur ten times or fewer per day.

801.3.3.2.2 (8.3.3.2.2)Conformance.

Conformance to the requirements in Section 801.3.3.2 (8.3.3.2) shall be demonstrated either through the design requirements of Section 801.3.3.2.3 (8.3.3.2.3) or the testing requirements of Section 801.3.3.2.4 (8.3.3.2.4).

801.3.3.2.3 (8.3.3.2.3)Interior Background Noise—Design.

Conformance with the provisions of this section shall be demonstrated.

801.3.3.2.3.1 (8.3.3.2.3.1)Building Envelope.

The composite sound transmission class (cSTC) for the building envelope shall be calculated and used in determining the maximum interior background sound pressure levels for room types listed in Table 801.3.3.2 (8.3.3.2).

801.3.3.2.3.2 (8.3.3.2.3.2)Interior Systems.

Interior noise from HVAC systems shall be calculated for room types listed in Table 801.3.3.2 (8.3.3.2) and used in determining the maximum interior background sound pressure levels for the room types listed in Table 801.3.3.2 (8.3.3.2).

801.3.3.2.3.3 (8.3.3.2.3.3)Penetrations and Fenestrations.

All penetrations through, and fenestrations within, sound rated assemblies shall be sealed in accordance with ASTM C919 and installed per the manufacturer's recommendations.

801.3.3.2.3.4 (8.3.3.2.3.4)Inspection.

Construction of acoustical items required in Sections 801.3.3.2.3 (8.3.3.2.3) through 801.3.3.2.3.3 (8.3.3.2.3.3) shall be visually inspected by an approved agency.

801.3.3.2.4 (8.3.3.2.4)Interior Background Noise—Testing.

Acceptance testing shall be performed in accordance with Section 1001.3.1.1.5 (10.3.1.1.5). Noise from construction activities, emergency vehicles, and sirens need not be considered.

801.3.3.3 (8.3.3.3)Interior Sound Transmission.

Interior wall and floor-ceiling assemblies separating adjacent interior spaces shall be designed and constructed to provide airborne sound isolation that complies with the minimum cSTC values specified in Table 801.3.3.3 (8.3.3.3). For wall and floor-ceiling assemblies separating different room types, the greater of the two cSTC values shall apply. Floorceiling assemblies separating adjacent interior spaces shall be designed and constructed to provide impact sound isolation that complies with the minimum IIC values specified in Table 801.3.3.3 (8.3.3.3). For floor-ceiling assemblies separating different room types, the IIC value associated with the room on the story below shall apply.

TABLE 801.3.3.3 (TABLE 8.3.3.3)

MINIMUM SOUND AND IMPACT SOUND RATINGS

ROOM TYPE	cSTC c,d	IIC
Dwelling unit (apartment, condominium, duplex, hotel guest room, etc.)	55	55
Retail or restaurant	50	45
Exercise, gym or pool b	55	50 a
Mechanical, electrical, and elevator machinery rooms b	60	N/A e

Conference and teleconference rooms	50	50
Enclosed offices	45	45
Open offices	N/A e	45

a.The IIC value listed addresses footfall noise but not exercise-related vibration-borne sound. Exercise-related vibration-borne sound shall comply with the requirements of Section 801.3.3.2 (8.3.3.2).
b.Minimum cSTC and IIC values are not required between adjacent rooms of the same room type.
c.For operable partitions and walls containing doors, windows, or both, the minimum cSTC ratings shall be 5 less than the values listed in Table 801.3.3.3 (8.3.3.3).
d.The minimum cSTC values shall be 5 less than the cSTC values in Table 801.3.3.3 (8.3.3.3) for walls between spaces and corridors and between spaces and open offices. The minimum cSTC values shall be 15 less than the cSTC values specified in Table 801.3.3.3 (8.3.3.3) for walls having doors that open to corridors or open offices.
e.Not applicable.

801.3.3.3.1 (8.3.3.3.1)Conformance.

Conformance to the requirements in Section 801.3.3.3 (8.3.3.3) shall be demonstrated either through the design requirements of Section 801.3.3.3.2 (8.3.3.3.2) or testing requirements of Section 801.3.3.3.3 (8.3.3.3.3).

801.3.3.3.2 (8.3.3.3.2)Interior Sound Transmission—Design.

Wall and floor-ceiling assemblies shall comply with the following:

a.Assemblies shall be required to provide sound isolation in accordance with this section and shall adjoin other intersecting sound isolating assemblies along all perimeter edges so as to provide continuity of sound isolation.
b.All partitions between spaces with different uses shall be full-height partitions or shall extend to a ceiling system with a ceiling attenuation class (CAC) rating equal to or greater than the wall cSTC rating, and all floor-ceiling assemblies shall be full-span assemblies connected to the walls/partitions.
c.Assemblies shall be sealed at all potential flanking paths and around all penetrations according to ASTM C919 and installed in accordance with the sealant manufacturer’s recommendations to achieve the assembly’s required performance rating.

801.3.3.3.2.1 (8.3.3.3.2.1) Inspection.

Construction of acoustical items required in Section 801.3.3.3.2 (8.3.3.3.2) shall be visually inspected by an approved agency.

801.3.3.3.3 (8.3.3.3.3)Interior Sound Transmission—Testing.

Acceptance testing shall be performed in accordance with Section 1001.3.1.1.5 (10.3.1.1.5).

801.3.3.4 (8.3.3.4)Interior Sound Reverberation.

The reverberation time T60 for designated spaces shall be calculated in accordance with ANSI/ASA S12.60-2010, Part 1, Annex A, for the octave bands 500, 1000, and 2000 Hz and shall not exceed the values specified in Table 801.3.3.4 (8.3.3.4) for fully furnished rooms.

TABLE 801.3.3.4 (TABLE 8.3.3.4)

MAXIMUM REVERBERATION TIME

ROOM TYPES	T60, sec
Meeting and banquet rooms < 3000 ft3 (85 m3)	0.8
Meeting and banquet rooms 3000 ft3 (85 m3) up to 8000 ft3 (225 m3)	1.0
Meeting and banquet rooms > 8000 ft3 (225m3) up to 30,000 ft3 (850 m3)	1.2
Meeting and banquet rooms > 30,000 ft3 (850 m3)	1.5
Enclosed offices	0.6
Conference/teleconference rooms	0.6
Open-plan offices	0.6
Courtrooms—unamplified speech	0.7
Courtrooms—amplified speech	1.0
Testing/research labs (tittle speech communication)	1.0
Labs (extensive phone use and speech communication)	0.6
Library study and reading areas	1.0
Gymnasiums and natatoriums	2.0

801.3.3.5 (8.3.3.5)Property Line Sound Levels.

Design and construction of mechanical systems for control of sound levels at the property line shall be in accordance with either the design provisions of Section 801.3.3.5.1 (8.3.3.5.1) or the testing provisions of Section 801.3.3.5.2 (8.3.3.5.2).

801.3.3.5.1 (8.3.3.5.1)Property Line Sound Levels—Design.

HVAC and other mechanical systems on the premises shall be designed to have a maximum hourly average sound pressure level Leq less than or equal to the values in Table 801.3.3.5.1 (8.3.3.5.1) at grade level and up to the highest potential window location on all property lines adjoining receiving properties. When generators are used for emergency power only, they shall be exempt from this criterion.

TABLE 801.3.3.5.1 (TABLE 8.3.3.5.1)

PROPERTY LINE MAXIMUM SOUND LEVELS—PRESCRIPTIVE OPTION

INITIATING PROPERTY	RECEIVING PROPERTY	HOURLY AVERAGE SOUND PRESSURE LEVEL Leq
All, except factory or industrial	All, except factory or industrial	50
Factory or industrial	All, except factory or industrial	55
Factory or industrial	Factory or industrial	75

801.3.3.5.2 (8.3.3.5.2)Property Line Sound Levels—Testing.

Sound produced by HVAC or other mechanical systems on the premises shall not exceed the values in Table 801.3.3.5.2 (8.3.3.5.2) at grade level and up to the highest window location on all property lines adjoining receiving properties. Where a generator is used only to provide emergency power, and all periodic operational testing is performed between the hours of 7:00 a.m. and 10:00 p.m., the sound produced by emergency generator during nighttime hours need only comply with the daytime maximum sound level values specified in Table 801.3.3.5.2 (8.3.3.5.2). Acceptance testing shall be performed in accordance with Section 1001.3.1.1.5.1.3 (10.3.1.1.5.1.3).

TABLE 801.3.3.5.2 (TABLE 8.3.3.5.2)

PROPERTY LINE MAXIMUM SOUND LEVELS—TESTED PERFORMANCE OPTION

INITIATING PROPERTY	RECEIVING PROPERTY	HOURLY AVERAGE SOUND PRESSURE LEVEL Leq	
		DAYTIME	NIGHTTIME
		7:00 A.M. TO 10:00 P.M.	10:00 P.M. TO 7:00 A.M.
All, except factory or industrial	All, except factory or industrial	60	50
Factory or industrial	All, except factory or industrial	65	55
Factory or industrial	Factory or industrial	75	75

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 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 gaspermeable 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) and (a), (b), or (c) as applicable.

a.Stone Aggregate Layer. The gas-permeable layer shall be a uniform layer not less than 4 in. (0.1 m) in depth and shall consist of gravel or crushed stone that meets ASTM C33 requirements for size numbers 5, 56, 57, or 6. Vent pipe openings to unobstructed interstices between stones within the gas-permeable layer shall not be less than the equivalent values indicated in Table 801.3.4.1.2 (8.3.4.1.2).
b.Small Stone, Sand, and Soil. The gas-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.
2.Sand classified in ASTM C33 as size number 9.
3.Soil that contains less than 35% sand, rock fragment fines, clay, and silt. Such clay and silt shall consist of not more than 10% high-plasticity clay or silt.

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

TABLE 801.3.4.1.2 (TABLE 8.3.4.1.2)

SOIL-GAS CONVEYANCE COMPONENTS

SYSTEM VENT PIPENOMINAL DIAMETER	MINIMUMDIAMETER OF PITS a	MINIMUM LENGTH OFPERFORATED PIPE ORGEOTEXTILE MATTING b
3 in. (0.08 m)	12 in. (0.30 m) diameter pit	18 ft (5.4 m)
4 in. (0.10 m)	16 in. (0.40) diameter pit	32 ft (10 m)
6 in. (0.15 m)	24 in. (0.60 m) diameter pit	71 ft (22 m)

a.Pits shall not be less than 4 in. (0.10 m) in depth.
b.Openings in perforated pipe and geotextile matting shall not be less than 1.0 in.2/ft (21 cm2/m) of pipe or matting length.

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 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 soilgas vent piping on the discharge side of the fan shall not be installed within or under occupied 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 801.3.4.1.3 (8.3.4.1.3).

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

VENT PIPE DIAMETER	MAXIMUM VENTED AREA PER VENT PIPE
3 in. (0.08 m)	2500 ft2 (230 m2)
4 in. (0.10 m)	4500 ft2 (420 m2)
6 in. (0.15 m)	10,000 ft2 (1000 m2)

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).

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, cafeterias, classrooms, and other training or lecture rooms shall be provided with multilevel lighting control. Lighting settings or the lighting controlled by each manual control shall be labeled at the control devices. The lighting in gymnasiums, auditoriums, ballrooms, and cafeterias shall also consist of at least two separately controlled groups of luminaires.

801.3.6 (8.3.6)Moisture Control.

Either a dynamic heat and moisture analysis, in accordance with ANSI/ASHRAE Standard 160, or steady-state water vapor 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, 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 around fenestration, door assemblies, and penetrations associated with mechanical equipment and utility services, except where there is a mechanism for drainage to the outdoors or where the materials are designed for long-term contact with water.

801.3.7 (8.3.7)Glare Control.

View fenestration for the spaces listed in Table 801.4.1.2A (8.4.1.2A) shall comply with this section.

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

Exceptions:

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

801.3.8 (8.3.8)Occupant Override.

Occupants shall have the capability to temporarily override automatic methods of glare control for periods not exceeding two hours.

801.4 (8.4)Prescriptive Option.

801.4.1 (8.4.1)Daylighting.

801.4.1.1 (8.4.1.1)Daylighting in Large Spaces Directly under a Roof and Having High Ceilings.

Enclosed spaces, including conditioned and unconditioned spaces, meeting all of the following criteria, shall comply with Sections 801.4.1.1.1, 801.4.1.1.2 and 801.4.1.1.3 (8.4.1.1.1, 8.4.1.1.2 and 8.4.1.1.3):

a.The space is in a building with three stories or fewer above grade.
b.The space area is greater than 2500 ft2 (232 m2).
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, 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 sidelighting effective aperture of not less than 0.15.
e.Secondary sidelighted areas shall have a sidelighting effective aperture of not less than 0.30.

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 0.40. 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.

TABLE 801.4.1.2A (TABLE 8.4.1.2A)

DAYLIT SPACES

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

TABLE 801.4.1.2B (TABLE 8.4.1.2B)

MINIMUM SIDELIGHTING EFFECTIVE APERTURE

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

801.4.1.3 (8.4.1.3) Shading for Offices.

For office spaces 250 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 or internal using the interior PF. 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 or interior PF.
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.

801.4.2 (8.4.2) Materials.

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 threeyear 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 topcoats, floor coatings, graphic arts (sign) coatings, hightemperature 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, swimmingpool 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 V.1.1, USEPA Method TO-17, and ASTM Standard Method D5197 within the scope of its

accreditation. Third-party certifiers shall be accredited to ISO/IEC 17065 and have the relevant certification program in the scope of accreditation.

801.4.2.2.2 (8.4.2.2.2)VOC Content 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 coatings, 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

Ceramic and concrete tile

Natural stone

Gypsum plaster

Clay masonry

Concrete masonry

Concrete

Metal

801.4.2.4 (8.4.2.4) Composite Wood, Wood 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, Airborne 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 (8.4.2.5)Office Furniture Systems and Seating.

Office furniture systems and seating installed prior to occupancy shall comply with the requirements of both Sections 801.4.2.5.1 (8.4.2.5.1) and 801.4.2.5.2 (8.4.2.5.2), based on testing according to ANSI/BIFMA M7.1.

801.4.2.5.1 (8.4.2.5.1)

At least 95% of the total number of installed office furniture system workstations, and at least 95% of the total number of seating units installed, shall comply with ANSI/BIFMA X7.1.

801.4.2.5.2 (8.4.2.5.2)

At least 50% of the total number of installed office furniture system workstations, and at least 50% of the total number of seating units installed, shall comply with Section 7.6.2 of ANSI/BIFMA e3.

801.4.2.6 (8.4.2.6)Ceiling and Wall Assemblies and Systems.

Ceiling and wall assemblies and systems include acoustical treatments, ceiling panels and tiles, gypsum panel products, tackable wall panels and coverings, wall coverings, and wall and ceiling paneling and planking. Emissions from these assemblies and systems 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 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.

801.4.2.6.1 (8.4.2.6.1)Deemed to Comply.

Ceiling and wall assemblies and systems that are composed of materials listed in Table 801.4.2.6.1 (8.4.2.6.1) shall be deemed to comply with the requirements of Section 801.4.2.6 (8.4.2.6). Where these products include integral organicbased 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 801.4.2.6.1 (TABLE 8.4.2.6.1)

CEILING AND WALL PRODUCTS DEEMED TO COMPLY WITH VOC EMISSION LIMITS

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

801.4.2.7 (8.4.2.7)Insulation.

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 TO-17, and ASTM Standard Method D5197 within the scope of its accreditation. Thirdparty certifiers shall be accredited to ISO/IEC 17065 and have the relevant certification program in the scope of accreditation.

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, gymnasia, big box retail, transportation facility terminal ticket counters, airport concourses, and nonrefrigerated warehouses.

Exceptions:

1. A space used for tasks or activities requiring routine dark conditions for more than 4 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 Normative 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 frontscreen projection units to no greater than 5 fc (50 lux) vertical illuminance, and the ratio of

maximumto-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 rearscreen 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.

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CHAPTER9
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,” 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-toenergy 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 onsite; 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)Total Waste.

For new building projects on sites with less than 5% existing buildings, structures, or hardscape, the total amount of construction waste generated prior to the issuance of the final certificate of occupancy on the project shall not exceed 42 yd3 or 12,000 lbs per 10,000 ft2 (35 m3 or 6000 kg per 1000 m2) of new building floor area. This shall apply to all waste, whether diverted, landfilled, incinerated, or otherwise disposed of. Excavated soil and landclearing debris shall not be included in the calculation. The amount of waste shall be tracked throughout the construction process in accordance with the construction waste management plan required in Section 901.3.1.3 (9.3.1.3).

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 comingled,
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 comingled 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.

901.3.2 (9.3.2)Extracting, Harvesting, and/or Manufacturing.

This section applies to all materials, products, and/or assemblies installed prior to the issuance of the final certificate of occupancy.

Materials shall be harvested and/or extracted, and products and/or assemblies shall be manufactured, according to the laws and regulations of the country of origin.

Wood products in the project, other than recovered or reused wood, shall not contain wood from endangered wood species unless the trade of such wood conforms with the requirements of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

901.3.3 (9.3.3)Refrigerants.

Chlorofluorocarbon (CFC) based refrigerants in HVAC&R systems shall not be used. Fire suppression systems shall not contain ozone-depleting substances (CFCs, hydrochlorofluorocarbons [HCFCs], or halons).

901.3.4 (9.3.4)Areas for Storage and Collection of Recyclables and Discarded Goods.

Areas for recyclables and discarded goods shall be provided as described in this section. These areas shall be coordinated with the anticipated collection services to maximize the effectiveness of the dedicated areas. Instructions regarding the identification and handling of recyclables and discarded goods in these areas shall be posted in or adjacent to each dedicated area.

901.3.4.1 (9.3.4.1)Recyclables.

There shall be 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.

901.3.4.2 (9.3.4.2)Reusable Goods.

For building projects with residential spaces, there shall be an area that serves the entire building and is designed for the collection and storage of discarded but clean items in good condition. Charitable organizations or others to arrange for periodic pickups shall be identified and posted.

901.3.4.3 (9.3.4.3)Fluorescent and High-Intensity Discharge (HID) Lamps and Ballasts.

An area shall be provided that serves the entire building, is designed for the collection and storage of fluorescent and HID lamps and ballasts, and facilitates proper disposal and/or recycling according to jurisdictional hazardous waste requirements.

901.3.4.4 (9.3.4.4)Electronics and Batteries.

Separate containers or areas shall be provided that serve the entire building; are designed for the collection and storage of electronics, alkaline batteries, and rechargeable batteries; and facilitate disposal and/or recycling according to jurisdictional requirements.

901.3.5 (9.3.5)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.
3.Mogul bi-pin-based lamps.
4.Preheat straight fluorescent lamps of any size.
5.U-bend and circline fluorescent lamps.
6.HID lamps.
7.Induction lamps.
8.Special-purpose lamps: appliance, black light, germicidal, bug, colored, grow, straight fluorescent reflector, reprographic, shatter resistant, cold temperature, and three-way lamps.

TABLE 901.3.5 (TABLE 9.3.5)

MAXIMUM MERCURY CONTENT FOR ELECTRIC LAMPS

LAMP	MAXIMUM MERCURY CONTENT
Screw-base compact fluorescent lamps < 25 W	4 mg
Screw-base compact fluorescent lamps ⩾ 25 W and < 40 W	5 mg
Pin-base compact fluorescent lamps, all wattages	5 mg
Straight fluorescent T5 normal lifetime lamps a	3 mg
Straight fluorescent T8 normal lifetime lamps a	4 mg
Straight fluorescent T5 and T8 long lifetime lamps b	5 mg
T12 eight-foot straight fluorescent lamps	15 mg

a.Electric lamps with a rated lifetime less than 25,000 hours when tested on an electronic fluorescent ballast, including T8 instant-start ballasts and T5 programmed-start ballasts, and turned OFF and ON every three hours.
b.Electric lamps with a rated lifetime equal to or greater than 25,000 hours when tested on an electronic fluorescent ballast, including T8 instant-start ballasts and T5 programmed-start ballasts, and turned OFF and ON every three hours.

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 products 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 concrete, 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 15% of building materials or products used, based on cost, shall be regionally extracted/harvested/recovered or manufactured within a radius of 500 mi (800 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 contribute 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 500 mi (800 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 percentagebased 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 comply when the annual average amount of certified wood products purchased by the vendor, for which they have chain of custody verification not older than two years, is 60% or greater of their total annual wood products purchased.

901.4.1.4 (9.4.1.4)Multiple-Attribute Product Declaration or Certification.

A minimum of ten different products installed in the building project at the time of issuance of certificate of occupancy shall comply with one of the following subsections. Declarations, reports, and assessments shall be submitted to the authority having jurisdiction (AHJ) and shall contain documentation of the critical peer review by an independent third party, results from the review, the reviewer’s name, company name, contact information, and date of the review or certification.

901.4.1.4.1 (9.4.1.4.1)Industry-Wide Declaration.

A Type III industry-wide environmental product declaration (EPD) shall be submitted for each product. Where the program operator explicitly recognizes the EPD as fully representative of the product group on a national level, it is considered industrywide. 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).

901.4.1.4.3 (9.4.1.4.3)Third-Party Multiattribute Certification.

A material-specific assessment shall be submitted for each product in accordance with one of the following standards, where applicable. The assessment shall be certified as meeting the minimum performance level specified in each 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

901.4.1.4.4 (9.4.1.4.4)Product Life Cycle.

A report by a third-party that has critically reviewed the lifecycle assessment (LCA) of a product, based on ISO Standards 14040 and 14044, shall be submitted. The report shall demonstrate compliance with the goal and scope for the cradle-to-gate requirements. Each product complying with this section shall be counted as two products for compliance with Section 901.4.1.4 (9.4.1.4).

901.5 (9.5)Performance Option

901.5.1 (9.5.1)Life-Cycle Assessment (LCA).

An LCA shall be performed in accordance with ASTM E2921 and ISO Standard 14044, as modified by this section, for a minimum of two building alternatives, both of which shall conform to the owner’s project requirements (OPR).

901.5.1.1 (9.5.1.1)LCA Performance Metric.

The LCA shall demonstrate that the final building design achieves one of the following minimum improvements over the reference building design assessed in the LCA:

a.Ten percent (10%) improvement in a minimum of each of two impact categories, one of which must be global warming.
b.Five percent (5%) improvement in a minimum of each of three impact categories, one of which must be global warming.

The following impact categories shall be used to determine compliance with this section and shall be included in the report described in Section 901.5.1.3 (9.5.1.3): land use, resource use, global warming, ozone layer depletion, human health effects, ecotoxicity, smog, acidification, and eutrophication.

901.5.1.2 (9.5.1.2)Procedure.

The LCA shall be performed in accordance with the service lives, life-cycle stages, study boundaries, and comparison methodologies of ASTM E2921 with the following modifications:

a.Each building alternative shall comply with Chapters 6, 7 and 8 (Sections 6, 7, and 8) of this code.
b.The service life of the buildings shall not be less than that determined using Table 1001.3.2.3 (10.3.2.3), except that the service life of long-life buildings shall be no less than 75 years.
c.Operating energy consumption shall be included or excluded at the discretion of the project team.
d.The LCA tool (or tools) or software shall include a published third-party impact indicator method.
e.The estimate of structural system material 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.

- **Collaborate and notate** questions and comments between colleagues and share externally with easy cut and paste.

10_CHAPTER 10 CONSTRUCTION AND PLANS FOR OPERATION | 2018 2018 International Green Construction Code® (IgCC®) | ICC premiumACCESS

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CHAPTER 10
CONSTRUCTION AND PLANS FOR OPERATION

1001.1 (10.1) Scope.

This section specifies requirements for construction and plans for operation, including the *commissioning (Cx) process*, building *functional and performance testing (FPT)*, measurement and *verification* (M&V), energy use reporting, durability, transportation management, erosion and sediment control, construction, and indoor air quality (IAQ) during construction.

1001.2 (10.2) Compliance.

All of the provisions of Chapter 10 (Section 10) are mandatory provisions.

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 1000 gal (4000 L) per day.

1001.3.1.1.1.1 (10.3.1.1.1.1) Activities Prior to Building Permit for Facilities Using the FPT Process.

The following activities shall be completed before a permit is issued for any system requiring *FPT*:

a. Designate *FPT providers*. For systems that are required to comply with Section 1001.3.1.1.1 (10.3.1.1.1), *FPT providers* shall be *owner's* qualified employees, independent commissioning *(Cx) providers*, or qualified designers experienced with *FPT* on the designated systems. *FPT providers* shall be independent of the building system design and construction function and shall possess the necessary experience and 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.

1001.3.1.1.1.2 (10.3.1.1.1.2) Activities Prior to Building Occupancy for Facilities Using the FPT Process.

Before issuance of a certificate of occupancy, the *FPT providers* shall complete the following activities:

a. Installation and startup of the specified 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.

1001.3.1.1.1.3 (10.3.1.1.1.3) Documentation.

The completed project design and *FPT* documentation shall be provided to the *owner* and shall be retained with the project records.

1001.3.1.1.2 (10.3.1.1.2) Acoustical Control.

1001.3.1.1.2.1 (10.3.1.1.2.1) Acoustical Field Measurement.

Where required by Chapter 8 (Section 8), the *FPT* specified in Sections 1001.3.1.1.2.1.1 (10.3.1.1.2.1.1) through 1001.3.1.1.2.1.2 (10.3.1.1.2.1.2) shall be completed.

1001.3.1.1.2.1.1 (10.3.1.1.2.1.1) Interior Background Sound Levels.

The interior sound level shall be measured in accordance with ANSI S12.72 using a sound level meter in slow-response setting as defined in ANSI/ASA S1.4. The testing shall include not less than 10% of the rooms of each type specified in Table 801.3.3.2 (8.3.3.2) that has a prescribed maximum *hourly average sound pressure level* L_{eq} dBA of 40 or less. The measured performance of the *spaces* shall not exceed the values specified in Table 801.3.3.2 (8.3.3.2) by greater than 5 dBA or 5 dBC.

1001.3.1.1.2.1.2 (10.3.1.1.2.1.2) Interior Sound Transmission.

The testing of interior sound transmission shall be in accordance with ASTM E336 with respect to noise isolation class (NIC) and ASTM E1007 with respect to impact sound rating (ISR). Tested NIC values shall not be more than five less than the composite sound transmission class (cSTC) values, and the ISR values shall not exceed 5 less than the impact insulation class (IIC) values in Table 801.3.3.3 (8.3.3.3). Testing shall be performed on not less than 10% of the partitions between rooms of each type in Table 801.3.3.3 (8.3.3.3) that has a prescribed cSTC or IIC of 50 or higher.

1001.3.1.1.2.1.3 (10.3.1.1.2.1.3) Property Line Sound.

Testing shall be performed at the locations and times of day or night that are estimated to most likely result in failure and shall be performed with all equipment operating under normal 100% load operation. If daytime test results comply with the nighttime requirements, nighttime testing is not required. The testing shall be in accordance with ANSI/ASA S1.13. The testing results shall comply with the property line noise levels in Table 801.3.3.5.2 (8.3.3.5.2). At the discretion of the *AHJ*, noise that is not created on the source property need not be included in the reported test results.

1001.3.1.2 (10.3.1.2) Building Project Commissioning (Cx) Process.

The *Cx process* shall be performed in accordance with this section using ANSI/ASHRAE/IES Standard 202 or other *generally accepted engineering standards* acceptable to the *AHJ*. The *Cx provider* shall verify that a *Cx process* has been incorporated into the design phases of the project and that commissioning shall be incorporated into the *construction documents*. The *Cx process* documents that the building and its commissioned components, assemblies, and systems comply with the *owner's project requirements (OPR)*. The project requirements, including *OPR, BoD*, design and construction record documentation, training plans and records, O&M plans and procedures, and Cx reports shall be assembled in a systems manual that provides information for building operating and 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) [7.4.6.1.1(f)].

d. Domestic hot-water systems and controls.

e. Water pumping and mixing systems over 5 hp (4kW) and purification systems.

f. Irrigation system performance that uses more than 1000 gal (4000 L) per day.

g. Renewable energy systems and energy storage systems.

h. Energy and building management and demand-control systems.

1001.3.1.2.2 (10.3.1.2.2) Cx Activities Prior to Building Permit.

The following activities shall be completed prior to issuance of a building permit:

a. A copy of the *Cx plan* in accordance with ANSI/ASHRAE/IES Standard 202 shall be submitted for review with the building permit application.

b. An *approved Cx provider* shall be 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 itemization of deficiencies found during testing and commissioning that have not been corrected at the time of report preparation;

c. Deferred tests that cannot be performed at the time of report preparation;

d. Documentation of the training of operating personnel and building occupants on 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) Building Envelope Airtightness.

Building envelope airtightness shall comply with ANSI/ASHRAE/IES Standard 90.1, with the following modifications and additions. Air leakage *verification* shall be determined in accordance with ANSI/ASHRAE/IES Standard 90.1, Section 5.9.2.2:

a. When implementing the testing option in ANSI/ASHRAE/IES Standard 90.1, Sections 5.9.2.2(b) and 5.4.3.1.3(a), whole-building pressurization testing shall meet the following requirements:

1. It shall be conducted in accordance with ASTM E779, ASTM E1827, CAN/CGSB-149.10, CAN/CGSB-149.15, ISO 9972, or equivalent standard by an independent third party.

2. The measured air leakage rate of the *building envelope* shall not exceed 0.25 cfm/ft^2 (1.25 L/s·m^2) 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*.

3. Section 501.4.3.1.3(a) [5.4.3.1.3(a)], Exception (1), is not allowed.

4. Section 501.4.3.1.3(a) [5.4.3.1.3(a)], Exception (2), is allowed where the measured air leakage rate exceeds 0.25 cfm/ft^2 (1.25 L/s·m^2) but does not exceed 0.40 cfm/ft^2 (2.0 L/s·m^2).

b. When implementing the *verification* program option in ANSI/ASHRAE/IES Standard 90.1, Section 5.9.2.2(a), the air barrier design review shall be performed by an independent third party.

1001.3.1.3.6 (10.3.1.3.6) Documentation.

Owner shall retain the systems manual and final Cx report.

1001.3.1.4 (10.3.1.4) Erosion and Sedimentation Control (ESC).

Develop and implement an ESC plan for all construction activities. The ESC plan shall conform to the erosion and sedimentation control requirements of the most current version of the USEPA NPDES General Permit for Stormwater Discharges from Construction Activities, or local erosion and sedimentation control standards and codes, whichever is more stringent, and regardless of size of project.

1001.3.1.5 (10.3.1.5) IAQ Construction Management.

Develop and implement an IAQ construction management plan to include the following:

a. Air conveyance materials shall be stored and covered so that they remain clean. All filters and controls shall be in place and operational when HVAC systems are operated during building flush-out or baseline IAQ monitoring. Except for system startup, testing, balancing, and commissioning, permanent HVAC systems shall not be used during construction.

b. After construction ends, prior to occupancy and with all interior finishes installed, a postconstruction, preoccupancy building flush-out as described under Section 1001.3.1.5(b)(1) [10.3.1.5(b)(1)], or postconstruction, preoccupancy baseline IAQ monitoring as described under Section 1001.3.1.5(b)(2) [10.3.1.5(b)(2)], shall be performed:

1. **Postconstruction, preoccupancy flushout.** 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 flushout 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 ft^2 (1.5 L/s per m^2) of *outdoor air*, or the outdoor airflow rate determined in Section 801.3.1.1 (8.3.1.1), 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.

$$\text{TAC} = V_{ot} \times \frac{1}{A} \times \frac{1}{H} \times 60 \text{ min/h} \times 24 \text{ h/day} \times 14 \text{ days} \quad \text{(I-P)}$$

$$\text{TAC} = V_{ot} \times \frac{1 \text{ m}^3}{1000L} \times \frac{1}{A} \times \frac{1}{H} \times 3600 \text{ s/h} \times 24 \text{ h/day} \times 14 \text{ days} \quad \text{(SI)}$$

(Equation 10-1)

where:

TAC = total air changes.

V_{ot} = system design *outdoor air* intake flow, cfm (L/s) (according to ANSI/ASHRAE Standard 62.1).

A = floor area, ft^2 (m^2).

H = ceiling height, ft (m).

2. **Postconstruction, preoccupancy 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 ft^2 (2500 m^2) or (ii) in each contiguous floor area. For each sampling point where the maximum concentration limits are exceeded, conduct additional 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.

TABLE 1001.3.1.5 (TABLE 10.3.1.5)
MAXIMUM CONCENTRATION OF AIR POLLUTANTS RELEVANT TO IAQ

CONTAMINANT	MAXIMUM CONCENTRATION, µg/m^3 (UNLESS OTHERWISE NOTED)
Nonvolatile Organic Compounds	
Carbon monoxide (CO)	9 ppm and no greater than 2 ppm above outdoor levels
Ozone	0.075 ppm (8-h)
Particulates (PM2.5)	35 (24 h)
Particulates (PM10)	150 (24 h)
Volatile Organic Compounds	
Acetaldehyde	140
Acrylonitrile	5
Benzene	60
1,3-butadiene	20
t-butyl methyl ether (methyl-t-butyl ether)	8000
Carbon disulfide	800
Caprolactam [a]	100

Carbon tetrachloride	40
Chlorobenzene	1000
Chloroform	300
1,4-dichlorobenzene	800
Dichloromethane (methylene chloride)	400
1,4-Dioxane	3000
Ethylbenzene	2000
Ethylene glycol	400
Formaldehyde	33
2-Ethylhexanoic acid [a]	25
n-Hexane	7000
1-methyl-2-pyrrolidinone [a]	160
Naphthalene	9
Nonanal [a]	13
Octanal [a]	7.2
Phenol	200
4-phenylcyclohexene (4 PCH) [a]	2.5
2-propanol (isopropanol)	7000
Styrene	900
Tetrachloroethene (tetrachloroethylene, perchloroethylene)	35
Toluene	300
1,1,1-trichloroethane (methyl chloroform)	1000
Trichloroethene (trichloroethylene)	600
Xylene isomers	700
Total volatile organic compounds (TVOC)	—[b]

a. This test is only required if carpets and fabrics with styrene butadiene rubber (SBR) latex backing material are installed as part of the base building systems.
b. TVOC reporting shall be in accordance with CDPH/EHLB/Standard Method V1.1 and shall be in conjunction with the individual VOCs listed.

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/m^3). Where radon testing indicates that the indoor radon concentration is 2.7 pCi/L (100 Bq/m^3) or greater, radon mitigation shall be conducted in accordance with ANSI/AARST RMS-LB, and the building shall be retested to verify that the radon concentration is below 2.7 pCi/L (100 Bq/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) Site Sustainability.

A *site* sustainability portion of the plan for operation shall be developed and shall contain the following provisions:

a. Where trees and vegetation are used to comply with the shade requirements of Section 501.3.5 (5.3.5), the plan for operation shall include the maintenance procedures needed to maintain healthy vegetation growth. The plan shall also outline the procedures for replacing any vegetation used to comply with the provisions in Chapter 5 (Section 5).
b. For *roof* surface materials selected to comply with the requirements of Section 501.3.5.3 (5.3.5.3), the plan for operation shall include the

maintenance procedures for keeping the *roof* surfaces cleaned in accordance with manufacturer's recommendations.

c. For vegetated terrace and roofing systems selected to comply with Section 501.3.5.5 (5.3.5.5), the plan for operation shall include the maintenance procedures needed to maintain healthy vegetation growth and *roof* membrane system. The plan shall also outline the procedures for replacing any vegetation used to comply with the provisions in Chapter 5 (Section 5).

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.

1001.3.2.1.2.3 (10.3.2.1.2.3) Documentation of Water Use.

All documents associated with the M&V of the building's water use shall be retained by the *owner* for a minimum of three years.

1001.3.2.1.3 (10.3.2.1.3) Energy Efficiency.

The plan for operation shall specify energy performance *verification* activities for *building projects* to track and assess building energy performance. The plan shall describe the procedures needed to comply with the requirements outlined in the following 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) IAQ.

The plan for operation shall include the requirements of Chapter 8 (Section 8) of ASHRAE Standard 62.1 and shall describe additional procedures, as outlined in Sections 1001.3.2.1.4.1 (10.3.2.1.4.1) through 1001.3.2.1.4.6 (10.3.2.1.4.6), for implementing a regular indoor environmental quality M&V program after building occupancy.

1001.3.2.1.4.1 (10.3.2.1.4.1) Outdoor Airflow Measurement.

The plan for operation shall document procedures for implementing a regular outdoor airflow monitoring program after building occupancy and shall meet the following requirements:

a. For each mechanical ventilation system where direct outdoor airflow measurement is required according to Section 801.3.1.2 (8.3.1.2), a procedure shall be in place to respond when there is notification that the *minimum outdoor airflow* is in an *outdoor air fault condition*. For systems that use a damper indicator instead of a direct measurement, per the exception to Section 801.3.1.2 (8.3.1.2), a procedure shall be in place to respond when there is notification that the indicator identifies that the damper is out of position.

b. For each mechanical ventilation system where direct *minimum outdoor airflow* measurement is required according to Section 801.3.1.2 (8.3.1.2), the *minimum outdoor airflow* shall be recorded every three months in either electronic or written form.

c. For systems that use a damper indicator per the exception to Section 801.3.1.2 (8.3.1.2), the *minimum outdoor airflow* shall be measured and recorded in either electronic or written form every two years for air-handling systems with a design supply airflow rate of more than 2000 cfm

(1000 L/s). The *minimum outdoor airflow* shall be measured using methods as described in ANSI/ASHRAE Standard 111 and with an accuracy of

±10% or better.

1001.3.2.1.4.2 (10.3.2.1.4.2) Outdoor Airflow Scheduling.

Ventilation systems shall be operated such that *spaces* are ventilated when these *spaces* are expected to be occupied.

1001.3.2.1.4.3 (10.3.2.1.4.3) Outdoor Airflow Documentation.

The following documentation shall be maintained concerning outdoor airflow M&V:

a. A list of each air system requiring direct outdoor airflow measurement.
b. Monitoring procedures and monitoring frequencies for each monitored sensing device, including a description of the specific response measures to be taken if needed.
c. Ventilation systems shall be operated such that *spaces* are ventilated when these *spaces* are expected to be occupied.
d. Operation and calibration check procedures and the records associated with operation checks and recalibration.

1001.3.2.1.4.4 (10.3.2.1.4.4) IAQ.

The plan for operation shall document procedures for maintaining and monitoring IAQ after building occupancy and shall contain the following:

a. For buildings located in nonattainments areas for PM2.5, as defined by USEPA, air filtration and/or air cleaning equipment, as defined in Section 801.3.1.3(a) [8.3.1.3(a)], shall be operated continuously during occupied hours or when the USEPA Air Quality Index exceeds 100 or equivalent designation by the local authorities for PM2.5.

Exception: *Spaces* without mechanical ventilation.

b. 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 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.

c. Biennial monitoring of IAQ by one of the following methods:
   1. Performing IAQ testing as described in Section 1001.3.1.4 (10.3.1.4).
   2. Monitoring occupant perceptions of IAQ by any method, including but not limited to occupant questionnaires.
   3. Each building shall have an occupant complaint/response program for IEQ.
d. For buildings where radon mitigation is required under Section 1001.3.1.9 (10.3.1.9), operation, maintenance, and monitoring procedures shall include all of the following:
   1. Quarterly inspection to verify operation of fans and other mechanical components.
   2. Biennial radon testing in accordance with AARST MALB to verify that radon concentrations remain below 2.7 pCi/L (100 Bq/m^3). Where radon testing indicates that the indoor radon concentration is 2.7 pCi/L (100 Bq/m^3) or greater, mitigation shall be conducted in accordance with AARST RMS-LB, and the building shall be retested to verify that the radon concentration is below 2.7 pCi/L (100 Bq/m^3).

      Where the required effectiveness of mitigation systems is consistently demonstrated for a period of not less than eight years, and such systems are inspected quarterly to verify fan operation, radon testing shall be repeated at intervals of not less than every five years.
   3. Biennial inspection and repair as needed for mitigation system performance indicators, fans, and visible mitigation system components, including piping, fasteners, supports, labels, and soil-gas barrier closures at exposed membranes, sumps, and other openings between soil and interior *space*.
   4. Documentation and retention of inspection and repair records and testing reports.

1001.3.2.1.4.5 (10.3.2.1.4.5) Building Green Cleaning Plan.

A green cleaning plan shall be developed for the *building project* in compliance with Green Seal Standard GS-42.

Exception: *Dwelling units* of a *building project*.

1001.3.2.1.4.6 (10.3.2.1.4.6) Moisture Measurement.

The plan for operation shall document procedures for implementing a regular humidity sensor monitoring program after building occupancy. Such procedures shall include provisions for the following:

a. For systems complying with Section 801.3.1.4 (8.3.1.4), using relative humidity sensors to determine *HVAC zone* relative humidity directly, or using dew-point and zone temperature sensors to determine *HVAC zone* relative humidity indirectly, the relative humidity determined shall be checked annually and compared to the relative humidity established using methods described in ASHRAE Standard 111.
b. Sensors shall be cleaned or repaired and recalibrated as necessary to ensure that sensor measurements are within 10% of actual relative humidity measurements.

1001.3.2.1.5 (10.3.2.1.5) Indoor Environmental Quality Survey.

The plan for operation shall include an indoor environmental quality occupant survey complying with all of the following:

a. The survey shall be implemented within a period of 6 to 18 months after issuance of the certificate of occupancy. The survey shall be repeated not less often than once every three years.
b. The survey questions shall include satisfaction questions and diagnostic questions for IAQ, lighting, acoustics, and thermal comfort. The survey questions shall use a seven-point satisfaction scale and comply with ANSI/ASHRAE Standard 55, Section 7.3.1.1.
c. A plan for reporting the survey results shall be produced that includes the following:
   1. The survey report shall state where the response rate was less than the response rates specified in ASHRAE Standard 55, Section 7.3.1.
   2. The survey report shall indicate the percentage of satisfaction for each question in accordance with ASHRAE Standard 55, Section 7.4.1(a).
   3. The percentage satisfaction results shall be compared to a nationally recognized survey benchmarking database where the building occupancy category is represented in the databases of nationally recognized organizations.

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) Service Life Plan.

A service life plan that is consistent with the OPR shall be developed to estimate to what extent structural, *building envelope* (not mechanical and electrical), and *hardscape* materials will need to be repaired or replaced during the service life of the building. The design service life of the building shall be no less than that determined using Table 1001.3.2.3 (10.3.2.3). The estimated service life shall be documented for building assemblies, products, and materials that will need to be inspected, repaired, and/or replaced during the service life of the building. *Site* improvements and *hardscape* shall also be included. Documentation in the service life plan shall include the *building project* design service life and basis for determination, and the following for each assembly or component:

a. Building assembly description.
b. Materials or products.
c. Design or estimated service life in years.
d. Maintenance frequency.
e. Maintenance access for components with an estimated service life less than the service life of the building.

Provide a service life plan at the completion of design development. The *owner* shall retain a copy of the service life plan for use during the life of building.

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

CATEGORY	MINIMUM SERVICE LIFE	BUILDING TYPES
Temporary	Up to 10 years	Nonpermanent construction buildings (sales offices, bunkhouses) Temporary exhibition buildings
Medium life	25 years	Industrial buildings Stand-alone parking structures
Long life	50 years	All buildings not temporary or medium life, including the parking structures below buildings designed for long life category

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.

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.

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CHAPTER11NORMATIVE REFERENCES

Section numbers indicate where the reference occurs in this document.

AARST

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

ANSI/AHAM RAC-1-R2015

Room Air Conditioners

Appendix B

AHRI

ANSI/AHRI 210/240-2008 (with Addenda 1 and 2)

Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment

Appendix B

ANSI/AHRI 310/380-2014

Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-14)

Appendix B

AHRI 340/360-2015 (I-P)

Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment

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ANSI/AHRI 365-2009

Performance Rating of Commercial and Industrial Unitary Air-Conditioning Condensing Units

Appendix B

ANSI/AHRI 460-2005

Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers

Appendix B

ANSI/AHRI 1230-2010 (with Addendum 2)

Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment

Appendix B

AMCA

ANSI/AMCA 220-05 (R2012)

Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating

701.4.2.4 (7.4.2.4)

ANSI

ANSI Z21.10.3-2015

Gas Water Heaters, Volume 3, Storage Water Heaters with Input Ratings above 75,000 Btu/h, Circulating and Instantaneous

Appendix B

ANSI Z21.11.2-2013

Gas-fired room heaters, volume II, unvented room heaters

801.3.1.5 (8.3.1.5)

ANSI Z21.47-2012

Gas-Fired Central Furnaces

Appendix B

ANSI Z83.4-2015/CSA 3.7-2015

Non-recirculating direct gas-fired industrial air heaters

801.3.1.5 (8.3.1.5)

ANSI Z83.8-2013

Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces

Appendix B

ANSI Z83.19-2009/CSA 2.35-2009

Gas-fired high-intensity infrared heaters

801.3.1.5 (8.3.1.5)

ASA

ANSI/ASA S1.13-2005 (R2010)

Measurement of Sound Pressure Levels in Air

1001.3.1.1.2 (10.3.1.1.2)

ANSI/ASA S1.4-2014

Sound Level Meters

1001.3.1.1.2 (10.3.1.1.2)

ANSI/ASA S12.60-2009

Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 2: Relocatable Classroom Factors

801.3.3 (8.3.3), 801.3.3.4 (8.3.3.4)

ANSI/ASA S12.60-2010

Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools

801.3.3 (8.3.3)

ANSI/ASA 12.72-2015

Measuring the Ambient Noise Level in a Room

1001.3.1.1.2 (10.3.1.1.2)

ASABE

ASABE/ICC 802-2014

Landscape Irrigation Sprinkler and Emitter Standard

601.3.1.2.1 (6.3.1.2.1)

ASHE

2014 FGI Guidelines

Hospitals and Outpatient Facilities: Guidelines for Design and Construction of Hospitals and Outpatient Facilities

801.3.3 (8.3.3)

2014 FGI Guidelines

Residential Health, Care and Support Facilities: Guidelines for Design and Construction of Residential Health, Care, and Support Facilities

801.3.3 (8.3.3)

ASHRAE

ANSI/ASHRAE Standard 52.2-2017

Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

801.3.1.3 (8.3.1.3)

ANSI/ASHRAE Standard 55-2017

Thermal Environmental Conditions for Human Occupancy

801.3.2 (8.3.2)1001.3.2.1.5 (10.3.2.1.5)

ANSI/ASHRAE Standard 62.1-2016

Ventilation for Acceptable Indoor Air Quality

301.2 (3.2)701.4.3.2 (7.4.3.2)701.4.3.8 (7.4.3.8)801.3 (8.3)1001.3.1.5 (10.3.1.5)1001.3.2.1.4 (10.3.2.1.4)

ANSI/ASHRAE Standard 62.2-2016

Ventilation and Acceptable Indoor Air Quality in Residential Buildings

801.3.1 (8.3.1)801.3.1.1 (8.3.1.1)801.3.1.5 (8.3.1.5)

ANSI/ASHRAE/IES Standard 90.1-2016

Energy Standard for Buildings Except Low-Rise Residential Buildings

301.1 (3.1)301.2 (3.2)501.3.6 (5.3.6)701.3.1 (7.3.1)701.4.1 (7.4.1)701.4.2 (7.4.2)701.4.3 (7.4.3)701.4.4 (7.4.4)701.4.5 (7.4.5)701.4.6 (7.4.6)701.4.7 (7.4.7)701.4.8 (7.4.8)801.3.1.10 (8.3.1.10)1001.3.1.3.5 (10.3.1.3.5)Appendix AAppendix BAppendix C

ANSI/ASHRAE Standard 111-2008

Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems

801.3.1.2.2 (8.3.1.2.2)1001.3.2.1.4 (10.3.2.1.4)1001.3.2.1.4.6 (10.3.2.1.4.6)

ANSI/ASHRAE Standard 146-2011

Method of Testing and Rating Pool Heaters

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ANSI/ASHRAE Standard 154-2011

Ventilation for Commercial Cooking Operations

701.4.3.8.1 (7.4.3.8.1)

ANSI/ASHRAE Standard 160-2016

Criteria for Moisture-Control Design Analysis in Buildings

801.3.6 (8.3.6)

ANSI/ASHRAE Standard 169-2013

Climatic Data for Building Design Standards

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ANSI/ASHRAE/ASHE Standard 170-2013

Ventilation of Health Care Facilities

801.3.1 (8.3.1)

ANSI/ASHRAE/ACCA Standard 180-2012

Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems

301.2 (3.2)1001.3.2.2 (10.3.2.2)

ANSI/ASHRAE/IES Standard 202-2013

Commissioning Process for Buildings and Systems

1001.3.1.2 (10.3.1.2)1001.3.1.3 (10.3.1.3)

ASME

ASME A112.18.1-2012/CSA B125.1-12

Plumbing Supply Fittings

601.3.2.1 (6.3.2.1)

ASME A112.19.2-2013/CSA B45.1-13

Ceramic Plumbing Fixtures

601.3.2.1 (6.3.2.1)

ASME A112.19.14-2013

Six-Liter Water Closets Equipped with a Dual Flushing Device

601.3.2.1 (6.3.2.1)

ASME A112.19.19-2006

Vitreous China Nonwater Urinals

601.3.2.1 (6.3.2.1)

ASTM

ASTM C33

Standard Specification for Concrete Aggregates

801.3.4.1.2 (8.3.4.1.2)

ASTM C518-15

Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

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ASTM C919-12

Standard Practice for Use of Sealants in Acoustical Applications.

801.3.3.1.1 (8.3.3.1.1)801.3.3.2.3.3 (8.3.3.2.3.3)801.3.3.3.2 (8.3.3.3.2)

ASTM C920-14

Standard Specification for Elastomeric Joint Sealants

801.3.4.1.1 (8.3.4.1.1)

ASTM C1371-15

Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

501.3.5.4 (5.3.5.4)

ASTM C1549-09(2014)

Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer

501.3.5.4 (5.3.5.4)

ASTM D1003-13

Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics

301.2 (3.2)801.4 (8.4)801.4.1.1.3 (8.4.1.1.3)801.4.1.3 (8.4.1.3)

ASTM D1785-15

Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

801.3.4.1.3 (8.3.4.1.3)

ASTM D5197-09e1

Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)

801.4.2 (8.4.2)1001.3.1.5 (10.3.1.5)

ASTM E90-09

Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

801.3.3.1.1 (8.3.3.1.1)

ASTM E336-14

Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings

801.3.3.1.1 (8.3.3.1.1)

ASTM E408-13

Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques

501.3.5.4 (5.3.5.4)

ASTM E492-09s

Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine

801.3.3.1.1 (8.3.3.1.1)

ASTM E779-10

Standard Test Method for Determining Air Leakage Rate by Fan Pressurization

1001.3.1.3.5 (10.3.1.3.5)

ASTM E972-96 (2013)

Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight

301.2 (3.2)

ASTM E1007-14

Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission through FloorCeiling Assemblies and Associated Support Structures

801.3.3.1.1 (8.3.3.1.1)

ASTM E1643-11

Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

801.3.4.1.1 (8.3.4.1.1)

ASTM E1745-11

Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

801.3.4.1.1 (8.3.4.1.1)

ASTM E1827-11

Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door

1001.3.1.3.5 (10.3.1.3.5)

ASTM E1903-11

Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process

301.2 (3.2)

ASTM E1918-06(2015)

Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field

501.3.5.4 (5.3.5.4)

ASTM E1980-11

Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

501.3.5.4 (5.3.5.4)

ASTM E2399-11

Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems

501.3.5.5 (5.3.5.5)

ASTM E2843-17

Standard Specification for Demonstrating that a Building is in Walkable Proximity to Neighborhood Assets

501.3.1.1 (5.3.1.1)

ASTM E2844-15e1

Standard Specification for Demonstrating That a Building’s Location Provides Access to Public Transit

501.3.1.1 (5.3.1.1)

ASTM E2921-16

Standard Practice for Minimum Criteria for Comparing Whole Building Life Cycle Assessments for Use with Building Codes and Rating Systems

901.5.1 (9.5.1)

BIFMA

ANSI/BIFMA e3-2014

Furniture Sustainability Standard

801.4.2.5 (8.4.2.5)901.4.1.4.3 (9.4.1.4.3)

ANSI/BIFMA M7.1-2011 (R2016)

Standard Test Method For Determining VOC Emissions From Office Furniture Systems, Components and Seating

801.4.2.5 (8.4.2.5)801.5.2 (8.5.2)

ANSI/BIFMA X7.1-2011 (R2016)

Standard for Formaldehyde and TVOC Emissions of Low-Emitting Office Furniture Systems and Seating

801.4.2.5 (8.4.2.5)

CARB

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

CDPH/EHLB/Standard Method V1.1 (2010)

Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers—Version 1.1

801.4.2 (8.4.2)801.5.2 (8.5.2)Table 1001.3.1.5 (Table 10.3.1.5)Appendix D

CEN

EN14500:2008

Blinds and shutters—Thermal and visual comfort—Test and calculation methods

801.3.8 (8.3.8)

CGSB

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

CITES- 1973, amended 1979 and 1983

Convention on International Trade in Endangered Species of Wild Fauna and Flora

901.3.2 (9.3.2)

CRRC

ANSI/CRRC S100-2016

Standard Test Methods for Determining Radiative Properties of Materials

501.3.5.4 (5.3.5.4)

CTI

CTI ATC-105 (00)

Acceptance Test Code for Water Cooling Towers

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CTI ATC-105S (11)

Acceptance Test Code for Closed-Circuit Cooling Towers

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CTI ATC-106 (11)

Acceptance Test Code for Mechanical Draft Evaporative Vapor Condensers

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CTI STD-201RS (15)

Standard for the Certification of Water Cooling Tower Thermal Performance

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Green-e

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

GS-11, 3.2, October 26, 2016

Green Seal Standard for Paints, Coatings, Stains, and Sealers. Section 3.0: “Product-Specific Health and Environmental Requirements”

801.4.2.2.2 (8.4.2.2.2)

GS-36, 2.1, July 12, 2013

Standard for Adhesives for Commercial Use

801.4.2.1.2 (8.4.2.1.2)

GS-42, July 7, 2015

Standard for Commercial and Institutional Cleaning Services

1001.3.2.1.4.5 (10.3.2.1.4.5)

IA

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

Z124.9-2004

Plastic Urinal Fixtures

601.3.2.1 (6.3.2.1)

ICC

2018 IBC

International Building Code®

102.4102.6104.1

2018 IECC

International Energy Conservation Code®

102.4

2018 IEBC

International Existing Building Code®

102.4102.6

2018 IFC

International Fire Code®

102.4102.6501.3.5.5 (5.3.5.5)

2018 IFGC

International Fuel Gas Code®

102.4

2018 IMC

International Mechanical Code®

102.4

2018 IPC

International Plumbing Code®

102.4601.3.5.3 (6.3.5.3)

2018 IPMC

International Property Maintenance Code®

102.4102.6

2018 IRC

International Residential Code®

101.3.2 (2.2)102.4

2018 ICC PC

Performance Code for Buildings and Facilities®

102.4

IES

TM-15-2011 including addendum a

Luminaire Classification System for Outdoor Luminaires

501.3.6.2 (5.3.6.2)

LM-83-12: Approved Method

IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)

301.2 (3.2)801.5.1 (8.5.1)

ISO

ISO-9972-2015

Thermal Performance of Buildings—Determination of Air Permeability of Buildings—Fan Pressurization Method

1001.3.1.3.5 (10.3.1.3.5)

ISO-13256-1-1998

Water-Source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-Air and Brine-to-Air Heat Pumps

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ISO-13256-2-1998

Water-Source Heat Pumps—Testing and Rating for Performance—Part 2: Water-to-Water and Brine-to-Water Heat Pumps

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ISO 14025-2006

Environmental Labels and Declarations—Type III Environmental Declarations—Principles and Procedures

901.4.1.4 (9.4.1.4)

ISO 14040-2006

Environmental Management—Life Cycle Assessment—Principles and Framework

901.4.1.4 (9.4.1.4)

ISO 14044-2006

Environmental Management—Life Cycle Assessment— Requirements and Guidelines

901.5.1 (9.5.1)901.5.1.2 (9.5.1.2)

ISO 21930-2007

Sustainability in Building Construction—Environmental Declaration of Building Products

901.4.1.4 (9.4.1.4)

ISO/IEC-17025-2005 (Reviewed 2010)

General Requirements for the Competence of Testing and Calibration Laboratories

801.4.2 (8.4.2)

ISO/IEC 17065-2012

Conformity Assessment—Requirements for Bodies Certifying Products, Processes, and Services

801.4.2 (8.4.2)

ISO/IEC Guide 59-1994

Code of Good Practice for Standardization

901.4.1.3.1 (9.4.1.3.1)

NEMA

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

NFPA 70-2014

National Electrical Code

501.3.6.3 (5.3.6.3)

NFRC

ANSI/NFRC 200-2014

Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence

301.2 (3.2)

NSC

NSC 373-2013

Sustainable Production of Natural Dimension Stone

901.4.1.4 (9.4.1.4)

NSF

NSF/ANSI 44-2016

Residential Cation Exchange Water Softeners

601.3.5 (6.3.5)

NSF/ANSI 58-2016

Reverse Osmosis Drinking Water Treatment Systems

601.3.6 (6.3.6)

NSF/ANSI 140-2015

Sustainability Assessment for Carpet

901.4.1.4 (9.4.1.4)

NSF/ANSI 332-2015

Sustainability Assessment for Resilient Floor Coverings

901.4.1.4 (9.4.1.4)

NSF/ANSI 336-2011

Sustainability Assessment for Commercial Furnishings Fabric

901.4.1.4 (9.4.1.4)

NSF/ANSI 342-2014

Sustainability Assessment for Wallcovering Products

901.4.1.4 (9.4.1.4)

NSF/ANSI 347-2012

Sustainability Assessment for Single Ply Roofing Membranes

901.4.1.4 (9.4.1.4)

NSF/ANSI 350-2017

On-Site Residential and Commercial Water Reuse Systems

601.3.7 (6.3.7)

SCAQMD

SCAQMD Rule 1113r, Amended February 5, 2016

Architectural Coatings

801.4.2.2 (8.4.2.2)

SCAQMD Rule 1168, Amended January 7, 2005

Adhesive and Sealant Applications

801.4.2.1 (8.4.2.1)

TCNA

ANSI A138.1-2011

Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials

901.4.1.4 (9.4.1.4)

UL

UL 100-2012

Standard for Sustainability for Gypsum Boards and Panels

901.4.1.4 (9.4.1.4)

UL 102-2012

Standard for Sustainability for Door Leafs

901.4.1.4 (9.4.1.4)

UL 727-2006

Standard for Oil-Fired Central Furnaces

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UL 731-2012

Standard for Oil-Fired Unit Heaters

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U.S.Congress

EPAct 2005 HR6 Public Law 109-58

The Energy Policy Act (EPAct) of 2005

701.4.7.3 (7.4.7.3)

EISA 2007 HR6 Public Law 110-140

The Energy Independence and Security Act of 2007

701.4.7 (7.4.7)

USDA

7 CFR Part 3201 Subpart B, (Includes Rounds 1–7) August 29, 2011; Round 8, April 4, 2012; Round 9, November 19, 2012; Round 10, June 11, 2013

Guidelines for Designating Biobased Products for Federal Procurement; Designated Items

901.4.1.3 (9.4.1.3)

USDOE

10 CFR Part 430, App N

Uniform Test Method for Measuring the Energy Consumption of Furnaces

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USEPA

Code of Federal Regulations, Title 40 Part 50 (40 CFR 50), as amended July 1, 2004

National Primary and Secondary Ambient Air Quality Standards

801.3.1.3 (8.3.1.3)

EPA 420-F-07-063, November 2007

Green Vehicle Guide: Consider a SmartWay Vehicle Program—Requirements for Certified Passenger Vehicles

501.3.7 (5.3.7)

EPA 625/R-96/0106, January 1999

Compendium of Methods for the Determination of Toxic Organic Pollutants in Ambient Air, Sections TO-1, TO-11, TO-17

1001.3.1.5 (10.3.1.5)

February 16, 2012

NPDES General Permit for Stormwater Discharges From Construction Activities

1001.3.1.4 (10.3.1.4)

USEPA Method TO-17 (1999)

Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes

801.4.2 (8.4.2)

Version 1.0, August 1, 2012

ENERGY STAR Program Requirements for Uninterruptible Power Supplies

701.4.7 (7.4.7)

Version 1.0, August 14, 2009

WaterSense Specification for Flushing Urinals

601.3.2.1 (6.3.2.1)

Version 1.0, March 4, 2010

WaterSense Specification for Showerheads

601.3.2.1 (6.3.2.1)

Version 1.0, October 1, 2007

WaterSense Tank-Type High-Efficiency Lavatory Faucet Specification

601.3.2.1 (6.3.2.1)

Version 1.0, November 3, 2011

WaterSense Specification for Weather-Based Irrigation Controllers

601.3.1.2 (6.3.1.2)

Version 1.2, August 1, 2003

ENERGY STAR Program Requirements for Commercial Steam Cookers

701.4.7 (7.4.7)

Version 1.2, July 1, 2004

ENERGY STAR Program Requirements for Room Air Cleaners

701.4.7 (7.4.7)

Version 1.2, June 2, 2014

WaterSense Tank-Type High-Efficiency Toilet Specification

601.3.2.1 (6.3.2.1)

Version 1.2, May 8, 2009

ENERGY STAR Program Requirements for Commercial Griddles

701.4.7 (7.4.7)

Version 2.0, April 22, 2011

ENERGY STAR Program Requirements for Commercial Fryers

701.4.7 (7.4.7)

Version 2.0 December 31, 2015

ENERGY STAR Program Requirements for Lamps (Light Bulbs)

701.4.7 (7.4.7)

Version 2.0, February 1, 2013

ENERGY STAR Program Requirements for Commercial Ice Makers

601.3.2.5 (6.3.2.5)701.4.7 (7.4.7)

Version 2.0, June 25, 2012

ENERGY STAR Program Requirements for Commercial Dishwashers

601.3.2.5 (6.3.2.5)701.4.7 (7.4.7)

Version 2.0, June 26, 2013

ENERGY STAR Program Requirements for Imaging Equipment

701.4.7 (7.4.7)

Version 2.0, May 9, 2013

ENERGY STAR Program Requirements for Water Coolers

701.4.7 (7.4.7)

Version 2.0, May 29, 2015

ENERGY STAR Program Requirements for Luminaires

701.4.7.3 (7.4.7.3)

Version 2.0, October 1, 2011

ENERGY STAR Program Requirements for Hot Food Holding Cabinets

701.4.7 (7.4.7)

Version 2.2, October 7, 2015

ENERGY STAR Program Requirements for Commercial Ovens

701.4.7 (7.4.7)

Version 3.0, April 1, 2012

ENERGY STAR Program Requirements for Residential Ceiling Fans

701.4.7 (7.4.7)

Version 3.0, December, 20, 2013

ENERGY STAR Program Requirements for Boilers

701.4.7 (7.4.7)

Version 3.0, July 18, 2014

ENERGY STAR Program Requirements for Residential Water Heaters

701.4.7 (7.4.7)

Version 3.0, May 1, 2013

ENERGY STAR Program Requirements for Audio and Video

701.4.7 (7.4.7)

Version 3.0, October 1, 2012

ENERGY STAR Program Requirements for Dehumidifiers

701.4.7 (7.4.7)

Version 3.0, October 1, 2014

ENERGY STAR Program Requirements for Commercial Refrigerators and Freezers

701.4.7 (7.4.7)

Version 3.0, October 1, 2014

ENERGY STAR Program Requirements for Telephony

701.4.7 (7.4.7)

Version 3.1, January 1, 2012

ENERGY STAR Program Requirements for Geothermal Heat Pumps

701.4.7 (7.4.7)

Version 3.1, March 1, 2013

ENERGY STAR Program Requirements for Refrigerated Beverage Vending Machines

701.4.7 (7.4.7)

Version 3.2, April 1, 2012

ENERGY STAR Program Requirements for Residential Ventilating Fans

701.4.7 (7.4.7)

Version 4.0, February 20, 2015

ENERGY STAR Program Requirements and Criteria for Room Air Conditioners

701.4.7 (7.4.7)

Version 4.0, June 13, 2011

ENERGY STAR Program Requirements for Furnaces

701.4.7 (7.4.7)

Version 5.0, May 13, 2016

ENERGY STAR Program Requirements for Set-Top Boxes

701.4.7 (7.4.7)

Version 5.0, September 15, 2014

ENERGY STAR Program Requirements for Refrigerators and Freezers

701.4.7 (7.4.7)

Version 5.0, September, 15, 2015

ENERGY STAR Program Requirements for ASHPs and Central Air Conditioners

701.4.7 (7.4.7)

Version 6.0, April 29, 2015

ENERGY STAR Program Requirements Product Specification for Residential Dishwashers

601.3.2.2 (6.3.2.2)701.4.7 (7.4.7)

Version 6.1, August 12, 2014

ENERGY STAR Program Requirements for Computers

701.4.7 (7.4.7)

Version 7.0, May 2016

ENERGY STAR Program Requirements for Displays

701.4.7 (7.4.7)

Version 7.0, October 30, 2015

ENERGY STAR Program Requirements for Televisions

701.4.7 (7.4.7)

Version 7.1, May 20, 2015

ENERGY STAR Program Requirements for Clothes Washers

601.3.2.2 (6.3.2.2)701.4.7 (7.4.7)

WTO

WTO TBT-1994

WTO Technical Barriers to Trade (TBT) Agreement Annex 3 Code of Good Practice for the Preparation, Adoption and Application of Standards

901.4.1.3.1 (9.4.1.3.1)

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SourceURL: https://codes.iccsafe.org/content/IGCC2018/normative-appendix-a-climate-zones-and-prescriptive-building-envelope-and-duct-insulation-tables

2018 2018 International Green Construction Code® (IgCC®)

(First Printing: Sep 2018)

NORMATIVE APPENDIXA CLIMATE ZONES AND PRESCRIPTIVE BUILDING ENVELOPE AND DUCT INSULATION TABLES

(This is a normative appendix and is part of this code.)

Tables A101.1 (A-1) through A101.3 (A-3) appear twice in this appendix. The three tables are shown first with I-P units, followed by three tables with SI units.

For climate zones, see ANSI/ASHRAE/IES Standard 90.1, Section 5.1.4, and ANSI/ASHRAE Standard 169.

a.For locations in the United States and its territories, use ANSI/ASHRAE Standard 169, Table B-1, “U.S. States by State and County,” to determine the assigned climate zone and, where required, the assigned climate zone letter. Informative Note: Referenced Standard Reproduction Annex ASHRAE Standard 169 (included at the end of this document) contains an extraction of ANSI/ASHRAE Standard 169, Figure B-1, “Climate Zone for United States Counties,” (which is informative for Standards 90.1 and 189.1). ANSI/ASHRAE/IES Standard 90.1 Referenced Standard Reproduction Annex ASHRAE Standard 169 (included at the end of ANSI/ASHRAE/IES Standard 90.1) contains an extraction of ANSI/ASHRAE Standard 169, Table B-1, “U.S. States by State and County.”
b.For locations in Canada that are listed in ASHRAE Standard 169, Table A-5, “Canada Stations and Climate Zones,” use this table to determine the assigned climate zone number and, where required, the assigned climate zone letter. For locations in other international countries that are listed in ASHRAE Standard 169, Table A-6, “International Stations and Climate Zones,” use this table to determine the required climate zone number and, where required, the assigned climate zone letter. For all international locations that are not listed either in ASHRAE Standard 169, Table A-5 or Table A-6, use ASHRAE Standard 169, Section A3, “Climate Zone Definitions,” and Table A-3, “Thermal Climate Zone Definitions,” to determine both the climate zone number and letter. Informative Note: Reference Standard Reproduction Annex ASHRAE Standard 169 (included at the end of this document) contains an extraction of ASHRAE Standard 169, Section A3, “Climate Zone Definitions,” and Table A-3, “Thermal Climate Zone Definitions.” ANSI/ASHRAE/IES Standard 90.1 Referenced Standard Reproduction Annex ASHRAE Standard 169 (included at the end of ANSI/ASHRAE/IES Standard 90.1) contains an extraction of ASHRAE Standard 169, Table A-5, “Canada Stations and Climate Zones,” and Table A-6, “International Stations and Climate Zones.”

TABLE A101.1 (TABLE A-1)

(SUPERSEDES TABLE A2.4.2 IN ANSI/ASHRAE/IES STANDARD 90.1) SINGLE-RAFTER ROOF REQUIREMENTS (I-P)

CLIMATE	MINIMUM INSULATION R-VALUE OR MAXIMUM ASSEMBLY

ZONE	U-FACTOR		
	NONRESIDENTIAL	RESIDENTIAL	SEMIHEATED
0, 1	R-38 U-0.029	R-38 + R10 ciU-0.022	R-19U-0.055
2	R-38 + R10 ci U-0.022	R-38 + R10 ciU-0.022	R-19U-0.055
3, 4, 5	R-38 + R10 ciU-0.022	R-38 + R10 ciU-0.022	R-30U-0.036
6	R-38 + R10 ciU-0.022	R-38 + R10 ciU-0.022	R-38U-0.029
7, 8	R-38 + R15 ciU-0.020	R-38 + R15 ciU-0.020	R-38U-0.029

TABLE A101.2 (TABLE A-2)

(SUPERSEDES TABLE 6.8.2 IN ANSI/ASHRAE/IES STANDARD 90.1)
MINIMUM DUCT INSULATION R-VALUEa HEATING- AND COOLING-ONLY SUPPLY DUCTS AND RETURN DUCTS (I-P)

CLIMATE ZONE	DUCT LOCATION					
	EXTERIOR	VENTILATEDATTIC	UNVENTED ATTICABOVEINSULATEDCEILING	UNVENTED ATTICWITH ROOFINSULATION a	UNCONDITIONEDSPACE b	INDIRECTLYCONDITION c
Heating-Only Ducts						
0, 1, 2	None	None	None	None	None	None
3	R-6	None	None	None	R-6	None
4	R.6	None	None	None	R-6	None
5	R-8	R-6	None	None	R-6	None
6	R-8	R-8	R-6	None	R-6	None
7	R-10	R-8	R-8	None	R-6	None
8	R-10	R-10	R-8	None	R-8	None
Cooling-Only Ducts						
0, 1	R-6	R-8	R-10	R-6	R-6	None
2	R-6	R-8	R-10	R-6	R-6	None
3	R-6	R-8	R-8	R-6	R-3.5	None
4	R-3.5	R-6	R-8	R-3.5	R-3.5	None
5, 6	R-3.5	R-3.5	R-6	R-3.5	R-3.5	None
7, 8	R-1.9	R-3.5	R-3.5	R-3.5	R-3.5	None
Return Ducts						
0 to 8	R-6	R-6	R-6	None	None	None

a.Insulation R-values, measured in m2·k/kW, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of this table or Section 701.4.2 (7.4.2). Insulation resistance is measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 23.8 C at the installed thickness.
b.Includes crawlspaces, both ventilated and nonventilated.
c.Includes return air plenums with or without exposed roofs above.

TABLE A101.3 (TABLE A-3)

(SUPERSEDES TABLE 6.8.2 IN ANSI/ASHRAE/IES STANDARD 90.1)
MINIMUM DUCT INSULATION R-VALUEa COMBINED HEATING AND COOLING SUPPLY DUCTS AND RETURN DUCTS (I-P)

CLIMATEZONE	DUCT LOCATION

	EXTERIOR	VENTILATEDATTIC	UNVENTED ATTICABOVE INSULATEDCEILING	UNVENTEDATTIC WITH ROOFINSULATIONa	UNCONDITIONEDSPACEb	INDIRECTLYCONDITIONEDSI
Supply Ducts						
0, 1	R-8	R-8	R-10	R-6	R-6	None
2	R-8	R-8	R-8	R-6	R-8	None
3	R-8	R-8	R-8	R-6	R-8	None
4	R-8	R-8	R-8	R-6	R-8	None
5	R-8	R-8	R-8	R-3.5	R-8	None
6	R-10	R-8	R-8	R-3.5	R-8	None
7	R-10	R-8	R-8	R-3.5	R-8	None
8	R-10	R11	R11	R-3.5	R-8	None
Return Ducts						
0 to 8	R-6	R-6	R-6	None	None	None

a.Insulation R-values, measured in m2·k/kW, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of this table or Section 701.4.2 (7.4.2). Insulation resistance is measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 23.8 C at the installed thickness.
b.Includes crawlspaces, both ventilated and non-ventilated.
c.Includes return air plenums with or without exposed roofs above.

TABLE A101.1 (TABLE A-1)

(SUPERSEDES TABLE A2.4.2 IN ANSI/ASHRAE/IES STANDARD 90.1) SINGLE-RAFTER ROOF REQUIREMENTS (SI)

CLIMATE ZONE	MINIMUM INSULATION R-VALUE OR MAXIMUM ASSEMBLY U-FACTOR		
	NONRESIDENTIAL	RESIDENTIAL	SEMIHEATED
0, 1	R-6.7 U-0.165	R-6.7 + R-1.8 ci U-0.112	R-3.3 U-0.312
2	R-6.7 + R-1.8 ci U-0.112	R-6.7 + R-1.8 ci U-0.112	R-3.3 U-0.312
3, 4, 5	R-6.7 + R-1.8 ci U-0.112	R-6.7 + R-1.8 ci U-0.112	R-5.3 U-0.204
6	R-6.7 + R-1.8 ci U-0.112	R-6.7 + R-1.8 ci U-0.112	R-6.7 U-0.165
7, 8	R-6.7 + R-2.6 ci U-0.111	R-6.7 + R-2.6 ci U-0.111	R-6.7 U-0.165

TABLE A101.2 (TABLE A-2)

(SUPERSEDES TABLE 6.8.2 IN ANSI/ASHRAE/IES STANDARD 90.1) MINIMUM DUCT INSULATION R-VALUEa HEATING- AND COOLING-ONLY SUPPLY DUCTS AND RETURN DUCTS (SI)

CLIMATEZONE	DUCT LOCATION					
	EXTERIOR	VENTILATEDATTIC	UNVENTED ATTICABOVE INSULATEDCEILING	UNVENTED ATTICWITH ROOFINSULATIONa	UNCONDITIONEDSPACEb	INDIRECTLYCONDITIONEDSI
Heating-Only Ducts						

0, 1, 2	None	None	None	None	None	None
3	R-1.06	None	None	None	R-1.06	None
4	R-1.06	None	None	None	R-1.06	None
5	R-1.41	R-1.06	None	None	R 1.06	None
6	R-1.41	R-1.41	R-1.06	None	R 1.06	None
7	R-1.76	R-1.41	R-1.41	None	R-1.06	None
8	R-1.76	R-1.76	R-1.41	None	R-1.41	None
Cooling-Only Ducts						
0, 1	R-1.06	R-1.41	R-10	R-1.06	R-1.06	None
2	R-1.06	R-1.41	R-10	R-1.06	R-1.06	None
3	R-1.06	R-1.41	R-1.41	R-1.06	R-0.62	None
4	R-0.62	R-1.06	R-1.41	R-0.62	R-0.62	None
5, 6	R-0.62	R-0.62	R-1.06	R-0.62	R-0.62	None
7, 8	R-1.9	R-0.62	R-0.62	R-0.62	R-0.62	None
Return Ducts						
0 to 8	R-1.06	R-1.06	R-1.06	None	None	None

a.Insulation R-values, measured in m2·k/kW, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of this table or Section 701.4.2 (7.4.2). Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 23.8 C at the installed thickness.
b.Includes crawlspaces, both ventilated and non-ventilated.
c.Includes return air plenums with or without exposed roofs above.

TABLE A101.3 (TABLE A-3)

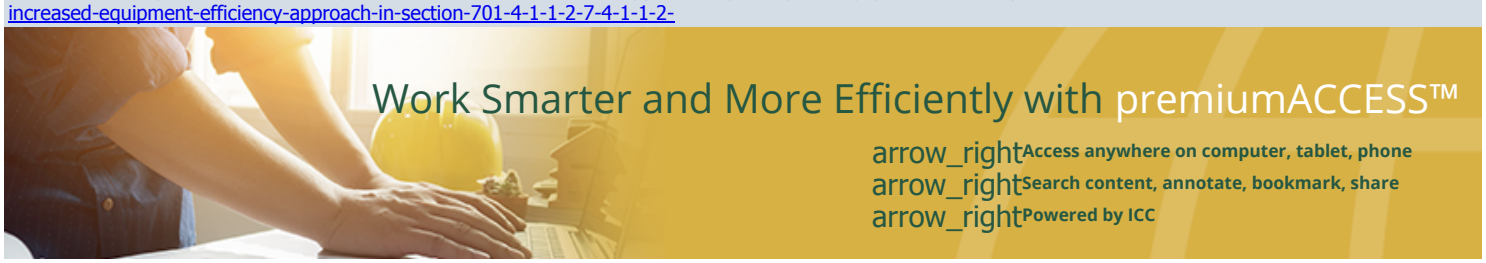
(SUPERSEDES TABLE 6.8.2 IN ANSI/ASHRAE/IES STANDARD 90.1)
MINIMUM DUCT INSULATION R-VALUEa COMBINED HEATING AND COOLING SUPPLY DUCTS AND RETURN DUCTS (SI)

CLIMATEZONE	DUCT LOCATION					
	EXTERIOR	VENTILATEDATTIC	UNVENTED ATTICABOVE INSULATEDCEILING	UNVENTEDATTIC WITH ROOFINSULATIONa	UNCONDITIONEDSPACEb	INDIRECTLYCONDITIONEDSI
Supply Ducts						
0, 1	R-1.41	R-1.41	R-1.76	R-1.06	R-1.06	None
2	R-1.41	R-1.41	R-1.41	R-1.06	R-1.41	None
3	R-1.41	R-1.41	R-1.41	R-1.06	R-1.41	None
4	R-1.41	R-1.41	R-1.41	R-1.06	R-1.41	None
5	R-1.41	R-1.41	R-1.41	R-0.62	R-1.41	None
6	R-1.76	R-1.41	R-1.41	R-0.62	R-1.41	None
7	R-1.76	R-1.41	R-1.41	R-0.62	R-1.41	None
8	R-1.76	R-1.94	R-1.94	R-0.62	R-1.41	None
Return Ducts						
0 to 8	R-1.06	R-1.06	R-1.06	None	None	None

a.Insulation R-values, measured in m2·k/kW, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface

condensation. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of this table or Section 701.4.2 (7.4.2). Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 23.8 C at the installed thickness."
b.Includes crawlspaces, both ventilated and non-ventilated.
c.Includes return air plenums with or without exposed roofs above.

13_NORMATIVE APPENDIX B PRESCRIPTIVE EQUIPMENT EFFICIENCY TABLES FOR THE ALTERNATE REDUCED RENEWABLES AND INCREASED EQUIPMENT EFFICIENCY APPROACH IN SECTION 701.4.1.1.2 (7.4.1.1.2)



NORMATIVE APPENDIX B
PRESCRIPTIVE EQUIPMENT EFFICIENCY TABLES FOR THE ALTERNATE REDUCED RENEWABLES AND INCREASED EQUIPMENT EFFICIENCY APPROACH IN SECTION 701.4.1.1.2 (7.4.1.1.2)

(This is a normative appendix and is part of this code.)

Informative Note: The first 11 tables appear in I-P units and are followed by 11 tables in SI units.

TABLE B101.1 (TABLE B-1)
(SUPERSEDES TABLE 6.8.1-1 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS—MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITIONS	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air conditioners, air cooled	< 65,000 Btu/h (one phase)	All	Split systems	15.0 SEER 12.5 EER	AHRI 210/240
			Single packaged	15.0 SEER 12.0 EER	
	< 65,000 Btu/h (three phase)	All	Split systems	15.0 SEER 12.5 EER	
			Single packaged	15.0 SEER 12.0 EER	
Through-the-*wall*, air cooled	< 30,000 Btu/h	All	Split systems	12.0 SEER	
			Single packaged	12.0 SEER	
Small duct, high velocity, air cooled	< 65,000 Btu/h (one phase)	All	Split systems	12.0 SEER	
Small duct, high velocity, air cooled	< 65,000 Btu/h (three phase)	All	Split systems	12.0 SEER	
Air conditioners, air cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	Split systems and single package	12.2 EER 14.0 IEER	AHRI 340/360
		All other	Split systems and single package	12.0 EER 13.8 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	Split systems and single package	12.2 EER 13.2 IEER	
		All other	Split systems and single package	12.0 EER 13.0 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric resistance (or none)	Split systems and single package	10.8 EER 12.3 IEER	
		All other	Split systems and single package	10.6 EER 12.1 IEER	
	≥ 760,000 Btu/h	Electric resistance (or none)	Split systems and single package	10.4 EER 11.6 IEER	
		All other	Split systems and single package	10.2 EER 11.4 IEER	
Air conditioners, water cooled	< 65,000 Btu/h	All	Split systems and single package	14.0 EER 15.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	Split systems and single package	14.0 EER 15.3 IEER	AHRI 340/360
		All other	Split systems and single	13.8 EER	

			package	15.1 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	Split systems and single package	14.0 EER 14.8 IEER	
		All other	Split systems and single package	13.8 EER 14.6 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric resistance (or none)	Split systems and single package	14.0 EER 14.8 IEER	
		All other	Split systems and single package	13.8 EER 14.6 IEER	
	≥ 760,000 Btu/h	Electric resistance (or none)	Split systems and single package	14.0 EER 14.8 IEER	
		All other	Split systems and single package	13.8 EER 14.6 IEER	
Air conditioners, evaporatively cooled	< 65,000 Btu/h	All	Split systems and single package	14.0 EER 15.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	Split systems and single package	14.0 EER 15.3 IEER	AHRI 340/360
		All other	Split systems and single package	13.8 EER 15.1 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	Split systems and single package	14.0 EER 14.8 IEER	
		All other	Split systems and single package	13.8 EER 14.6 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric resistance (or none)	Split systems and single package	14.0 EER 14.8 IEER	
		All other	Split systems and single package	13.8 EER 14.6 IEER	
	≥ 760,000 Btu/h	Electric resistance (or none)	Split systems and single package	14.0 EER 14.8 IEER	
		All other	Split systems and single package	13.8 EER 14.6 IEER	
Condensing units, air cooled	≥ 135,000 Btu/h			Not applicable match with indoor coil	AHRI 365
Condensing, water or evaporatively cooled	≥ 135,000 Btu/h			Not applicable match with indoor coil	

a. Chapter 11 (Section 11) contains a details on the referenced test procedures, including year and version of the test procedure.

TABLE B101.2 (TABLE B-2)
(SUPERSEDES TABLE 6.8.1-2 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITIONS	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air conditioners, air cooled (cooling mode)	< 65,000 Btu/h (one phase)	All	Split systems	15.0 SEER 12.5 EER	AHRI 210/240
			Single packaged	15.0 SEER 12.0 EER	
	< 65,000 Btu/h (three phase)	All	Split systems	15.0 SEER 12.5 EER	
			Single packaged	15.0 SEER 12.0 EER	
Through-the-*wall*, air cooled (cooling mode)	< 30,000 Btu/h	All	Split systems	12.0 SEER	
			Single packaged	12.0 SEER	
Small duct high velocity, air cooled (cooling mode)	< 65,000 Btu/h (one phase)	All	Split systems	12.0 SEER	
	< 65,000 Btu/h (three phase)	All	Split systems	12.0 SEER	
Air conditioners, air cooled (cooling mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	Split systems and single package	11.3 EER 12.3 IEER	AHRI 340/360
		All other	Split systems and single package	11.1 EER 12.1 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	Split systems and single package	10.9 EER 11.9 IEER	
		All other	Split systems and single package	10.7 EER 11.7 IEER	
	≥ 240,000 Btu/h	Electric resistance (or none)	Split systems and single package	10.3 EER 10.9 IEER	
		All other	Split systems and single package	10.1 EER 10.7 IEER	
Water-to-air water loop (cooling mode)	< 17,000 Btu/h	All	86°F entering water	14.0 EER	ISO-13256-1
	≥ 17,000 Btu/h and < 65,000 Btu/h	All	86°F entering water	14.0 EER	
	> 65,000 Btu/h and < 135,000 Btu/h	All	86°F entering water	14.0 EER	
Water-to-air ground water (cooling mode)	< 135,000 Btu/h	All	59°F entering water	18.0 EER	
Water-to-air ground loop (cooling mode)	< 135,000 Btu/h	All	77°F entering water	14.1 EER	
Water-to-water water loop (cooling mode)	< 135,000 Btu/h	All	86°F entering water	10.6 EER	ISO-13256-2
Water-to-water groundwater (cooling mode)	< 135,000 Btu/h	All	59°F entering water	16.3 EER	
Brine-to-water ground loop (cooing mode)	< 135,000 Btu/h	All	77°F entering water	12.1 EER	
Air conditioners, air cooled (heating	< 65,000 Btu/h (cooling capacity) (one	All	Split systems	9.00 HSPF	AHRI 210/240

mode)	phase)		Single packaged	8.50 HSPF	
	< 65,000 Btu/h (cooling capacity) (three phase)	All	Split systems	9.00 HSPF	
			Single packaged	8.50 HSPF	
Through-the-wall, air cooled (heating mode)	< 30,000 Btu/h (cooling capacity)	All	Split systems	7.40 HSPF	
			Single packaged	7.40 HSPF	
Small-duct high velocity, air cooled (heating mode)	< 65,000 Btu/h (cooling capacity) (one phase)	All	Split systems	7.20 HSPF	AHRI 210/240
	< 65,000 Btu/h (cooling capacity) (three phase)	All	Split systems	7.20 HSPF	
Air cooled (heating mode)	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)		47°F db/43°F wb *outdoor air*	3.40 COP_H	AHRI 340/360
			17°F db/15°F wb *outdoor air*	2.40 COP_H	
	≥ 135,000 Btu/h (cooling capacity)		47°F db/43°F wb *outdoor air*	3.20 COP_H	
			17°F db/15°F wb *outdoor air*	2.10 COP_H	
Water-to-air water loop (heating mode)	< 135,000 Btu/h (cooling capacity)		68°F entering water	4.60 COP_H	ISO-13256-1
Water-to-air groundwater (heating mode)	< 135,000 Btu/h (cooling capacity)		50°F entering water	3.70 COP_H	
Brine-to-air ground loop (heating mode)	< 135,000 Btu/h (cooling capacity)		32°F entering fluid	3.20 COP_H	
Water-to-water water loop (heating mode)	< 135,000 Btu/h (cooling capacity)		68°F entering water	3.70 COP_H	ISO-13256-2
Water-to-water groundwater (heating mode)	< 135,000 Btu/h (cooling capacity)		50°F entering water	3.10 COP_H	
Brine-to-water ground loop (heating mode)	< 135,000 Btu/h (cooling capacity)		32°F entering fluid	2.50 COP_H	

a. Chapter 11 (Section 11) contains details on the referenced test procedures, including year and version of the test procedure.

TABLE B101.3 (TABLE B-3)
(SUPERSEDES TABLE 6.8.1-4 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED SINGLE-PACKAGED VERTICAL AIR CONDITIONERS AND SINGLE-PACKAGED VERTICAL HEAT PUMPS AIR-CONDITIONER HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
PTAC (cooling mode) standard size	All capacities	95°F db *outdoor air*	14.4 – (0.300 × Cap/1000)[c] EER	AHRI 310/380
PTAC (cooling mode) nonstandard size[b]	All capacities	95°F db *outdoor air*	10.9 – (0.213 × Cap/1000)[c] EER	AHRI 310/380
PTHP (cooling mode) standard size	All capacities	95°F db *outdoor air*	14.4 – (0.300 × Cap/1000)[c] EER	ARI 310/380
PTHP (cooling mode) nonstandard size[b]	< 7000 Btu/h	95°F db *outdoor air*	10.8 – (0.213 × Cap/1000)[c] EER	ARI 310/380
PTHP (heating mode) new constructions	All capacities	47°F db/43°F wb *outdoor air*	3.7 – (0.052 × Cap/1000)[c] COP_H	ARI 310/380
PTHP (heating mode) nonstandard size[b]	All capacities	47°F db/43°F wb *outdoor air*	2.9 – (0.026 × Cap/1000)[c] COP_H	ARI 310/380

a. Chapter 11 (Section 11) contains a complete specification of the referenced test procedures, including year version of the test procedure.

b. Replacement units shall be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 in. high and less than 42 in. wide and having a cross-sectional area less than 670 $in.^2$.

c. "Cap" means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

TABLE B101.4 (TABLE B-4)
(SUPERSEDES TABLE 6.8.1-4 IN ANSI/ASHRAE/IES STANDARD 90.1) SINGLE-PACKAGED VERTICAL AIR CONDITIONERS, SINGLE-PACKAGED VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS, AND ROOM AIR-CONDITIONER HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY BASE	MINIMUM EFFICIENCY CONNECTED[b]	TEST PROCEDURE[a]
SPVAC (cooling mode)	< 65,000 Btu/h	95°F db/75°F wb *outdoor air*	14.0 SEER		AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/75°F wb *outdoor air*	11.2 EER 12.9 IEER		AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/75°F wb *outdoor air*	11.0 EER 12.4 IEER		
SPVHP (cooling mode)	< 65,000 Btu/h	95°F db/75°F wb *outdoor air*	14.0 SEER		AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/75°F wb *outdoor air*	11.0 EER 12.2 IEER		AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/75°F wb *outdoor air*	10.6 EER 11.6 IEER		
SPVHP (heating mode)	< 65,000 Btu/h	47°F db/43°F wb *outdoor air*	8.0 HSPF		AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	47°F db/43°F wb *outdoor air*	3.3 COP_H		AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	47°F db/43°F wb *outdoor air*	3.2 COP_H		
Room air conditioners, with louvered sides	< 6,000 Btu/h		12.1 *CEER*	11.5 *CEER*	ANSI/AHAM RAC-1
	≥ 6,000 Btu/h and < 8,000 Btu/h		12.1 *CEER*	11.5 *CEER*	
	≥ 8,000 Btu/h and < 14,000 Btu/h		12.0 *CEER*	11.5 *CEER*	
	≥ 14,000 Btu/h and < 20,000 Btu/h		11.8 *CEER*	11.2 *CEER*	
	≥ 20,000 Btu/h and < 28,000 Btu/h		10.3 *CEER*	9.8 *CEER*	
	≥ 28,000 Btu/h		9.9 *CEER*	9.4 *CEER*	
Room air conditioners, without louvered sides	< 6,000 Btu/h		11.0 *CEER*	10.5 *CEER*	
	≥ 6,000 Btu/h and < 8,000 Btu/h		11.0 *CEER*	10.5 *CEER*	
	≥ 8,000 Btu/h and < 11,000 Btu/h		10.6 *CEER*	10.1 *CEER*	

	≥ 11,000 Btu/h and < 14,000 Btu/h		10.5 *CEER*	10.0 *CEER*	
	≥ 14,000 Btu/h and < 20,000 Btu/h		10.2 *CEER*	9.7 *CEER*	
	≥ 20,000 Btu/h		10.3 *CEER*	9.8 *CEER*	
Room air conditioner heat pump, with louvered sides	< 20,000 Btu/h		10.8 *CEER*	10.3 *CEER*	
	≥ 20,000 Btu/h		10.2 *CEER*	9.7 *CEER*	
Room air conditioner heat pump, without louvered sides	< 14,000 Btu/h		10.2 *CEER*	9.7 *CEER*	
	≥ 14,000 Btu/h		9.6 *CEER*	9.1 *CEER*	
Room air conditioner, casement only	All capacities		10.5 *CEER*	10.0 *CEER*	
Room air conditioner, casement-slider	All capacities		11.4 *CEER*	10.8 *CEER*	

a. Chapter 11 (Section 11) contains details for the referenced test procedure, including the referenced year version of the test procedure.

b. Connected room air conditioners that are connected to utility programs are allowed a lower *CEER* value but must be in compliance with and certified per EnergyStar version 4.0 requirements for connected equipment.

TABLE B101.5 (TABLE B-5)

(SUPERSEDES TABLE 6.8.1-5 IN ANSI/ASHRAE/IES STANDARD 90.1) WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES, AND UNIT HEATERS—MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Warm-air furnace, gas fired (weatherized)	< 225,000 Btu/h	Maximum capacity [c]	81% AFUE [b]	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 225,000 Btu/h		80% E_t [d]	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-air furnace, gas fired (nonweatherized)	< 225,000 Btu/h	Maximum capacity [c]	90% AFUE[b,d] or 92% E_t	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 225,000 Btu/h		92% E_t[d]	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-air furnace, oil fired (weatherized)	< 225,000 Btu/h	Maximum capacity [c]	78% AFUE [b,d]	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	> 225,000 Btu/h		81% E_t [d]	Section 42, Combustion, UL 727
Warm-air furnaces, oil fired (nonweatherized)	< 225,000 Btu/h	Maximum capacity [c]	85% AFUE[b,d] or 87% E_t	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥ 225,000 Btu/h		87% E_t [d]	Section 42, Combustion, UL 727
Warm-air duct furnace, gas fired (weatherized)	All capacities	Maximum capacity [c]	80% E_c [e]	Section 2.10, Efficiency, ANSI Z83.8
Warm-air duct furnace, gas fired (nonweatherized)	All capacities	Maximum capacity [c]	90% E_c [e]	Section 2.10, Efficiency, ANSI Z83.8
Warm-air unit heater, gas fired (nonweatherized)	All capacities	Maximum capacity [c]	80% E_c [e,f]	Section 2.10, Efficiency, ANSI Z83.8
Warm-air unit heater, oil fired (weatherized)	All capacities	Maximum capacity [c]	90% E_c [e,f]	Section 40, Combustion, UL 731

a. Chapter 11 (Section 11) contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

b. Combination units not covered by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430 (three-phase power or cooling capacity greater than or equal to 65,000 Btu/h) may comply with either rating.

c. Compliance of multiple firing rate units shall be at the maximum firing rate.

d. E_t = thermal *efficiency*. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75% of the input rating, and have either power venting or a *flue damper*. A *vent damper* is an acceptable alternative to a *flue damper* for those furnaces where combustion air is drawn from the *conditioned space*.

e. E_c = combustion *efficiency* (100% less flue losses). See test procedure for detailed discussion.

f. As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an *automatic flue damper*.

TABLE B101.6 (TABLE B-6)

(SUPERSEDES TABLE 6.8.1-6 IN ANSI/ASHRAE/IES STANDARD 90.1) GAS- AND OIL-FIRED BOILERS—MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE[a]	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY[b,c]	TEST PROCEDURE[g]
Boilers, hot water	Gas fired	< 300,000 Btu/h[h,i]	89% AFUE[f,h]	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	89% E_t[f]	10 CFR Part 431
		> 2,500,000 Btu/h[a]	91% E_c[f]	
	Oil fired[e]	< 300,000 Btu/h	89% AFUE[f]	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	85% E_t[f]	10 CFR Part 431
		> 2,500,000 Btu/h[a]	86% E_c[f]	
Boilers, steam	Gas fired	< 300,000 Btu/h[i]	80% AFUE	10 CFR Part 430
	Gas fired all except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	79% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	79% E_t	
	Gas fired natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	77% E_t	
		> 2,500,000 Btu/h[a]	77% E_t	
	Oil fired[e]	< 300,000 Btu/h	82% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,5000,000 Btu/h[d]	81% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	81% E_t	

a. These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.

b. E_c = thermal efficiency (100% less flue losses). See reference document for detailed information.

c. E_t = thermal efficiency. See reference document for detailed information.

d. Maximum capacity—minimum and maximum ratings as provided for and allowed by the unit's controls.

e. Includes oil fired (residual).

f. Systems shall be designed with lower operating return hot-water temperatures (<130°F) and use hot-water reset to take advantage of the much higher efficiencies of condensing boilers.

g. Chapter 11 (Section 11) contains details for the referenced test procedure, including the referenced year version of the test procedure.

h. A boiler not equipped with a tankless domestic water-heating coil shall be equipped with an *automatic* means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.

i. Boilers shall not be equipped with a continuous pilot ignition system.

TABLE B101.7 (TABLE B-7)
(SUPERSEDES TABLE 6.8.1-7 IN ANSI/ASHRAE/IES STANDARD 90.1) PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT—MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITION[g]	PERFORMANCE REQUIRED [a,b,c,d,e,f,i]	TEST PROCEDURE[h]
Propeller or axial fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 42.1 gpm/hp	CTI ATC-105 and CTI STD-201RS
Centrifugal fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 22.0 gpm/hp	CTI ATC-105 and CTI STD-201RS
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 16.1 gpm/hp	CTI ATC-105S and CTI STD-201RS
Centrifugal fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 8.0 gpm/hp	CTI ATC-105S and CTI STD-201RS
Propeller or axial fan evaporative condensers	All	Ammonia test fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb	≥ 134,000 Btu/h·hp	CTI ATC-106
Centrifugal fan evaporative condensers	All	Ammonia test fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb	≥ 110,000 Btu/h·hp	CTI ATC-106
Propeller or axial fan evaporative condensers	All	R-507A test fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb	≥ 157,000 Btu/h·hp	CTI ATC-106
Centrifugal fan evaporative condensers	All	R-507A test fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb	≥ 135,000 Btu/h·hp	CTI ATC-106
Air-cooled condensers	All	190°F entering gas temperature 125°F condensing temperature 15°F subcooling 95°F entering wb	≥ 176,000 Btu/h·hp	AHRI 460

a. For purposes of this table, *open-circuit cooling tower performance* is defined as the water flow rating of the tower at the thermal rating condition listed in Table B101.7 (B-7) divided by the fan motor nameplate power.

b. For purposes of this table, *closed-circuit cooling tower performance* is defined as the process water flow rating of the tower at the thermal rating condition listed in Table B101.7 (B-7) divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.

c. For purposes of this table, *evaporative condenser performance* is defined as the heat rejected at the specified rating condition in the table divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power.

d. For purposes of this table, *air-cooled condenser performance* is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

e. The efficiencies and test procedures for both *open-* and *closed-circuit cooling towers* are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections. The certification requirements do not apply to field erected cooling towers.

f. All cooling towers, closed-circuit coolers, evaporative condensers, and air-cooled condensers shall comply with the minimum efficiency listed in the table for that specific type of equipment with the capacity effect of any project specific accessories and/or options included with the equipment.

g. Requirements for evaporative condensers are listed with ammonia (R-717) and R-507A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-507A must meet the minimum efficiency requirements listed for R-507A as the test fluid.

h. Informative Appendix G contains information on the referenced test procedures.

i. Not applicable for air-cooled condensers applied to condenserless chillers. The air-cooled condenser and condenserless chiller shall comply with the requirements for air-cooled chillers as defined in ANSI/ASHRAE/IES Standard 90.1, Table 6.8.1-3.

TABLE B101.8 (TABLE B-8)
(SUPERSEDES TABLE 7.8 IN ANSI/ASHRAE/IES STANDARD 90.1) PERFORMANCE REQUIREMENTS FOR SERVICE WATER HEATING EQUIPMENT (I-P)

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	RATED STORAGE VOLUME AND INPUT RATING (IF APPLICABLE)	DRAW PATTERN	PERFORMANCE REQUIRED[a]	TEST PROCEDURE[b]
Electric table-top water heaters[c]	≤ 12 kW	≥ 20 gal and ≤ 120 gal	Very small	UEF ≥ 0.6323 – 0.0058V	DOE 10 CFR Part 430
			Low	UEF ≥ 0.9188 – 0.0031V	
			Medium	UEF ≥ 0.9577 – 0.0023V	
			High	UEF ≥ 0.9844 – 0.0016V	
Electric resistance storage water heaters		≥ 20 gal and ≤ 55 gal	Very small	UEF ≥ 0.8808 – 0.0008V	DOE 10 CFR Part 430
			Low	UEF ≥ 0.9254 – 0.0003V	
			Medium	UEF ≥ 0.9307 – 0.0002V	
			High	UEF ≥ 0.9349 – 0.0001V	
		> 55 gal	Must use heat-pump water heater		
Electric resistance grid-enabled water heaters		> 75 gal	Very small	UEF ≥ 1.0136 – 0.0028V	DOE 10 CFR Part 430
			Low	UEF ≥ 0.09984 – 0.0014V	
			Medium	UEF ≥ 0.9853 – 0.0010V	
			High	UEF ≥ 0.9720 – 0.0007V	
Heat-pump water heaters		≤ 55 gal		EF ≥ 2.00, FHR ≥ 50 gal	DOE 10 CFR Part 430
		> 55 gal		EF ≥ 2.00, FHR ≥ 50 gal	

Gas-fired storage water heaters	≤ 75,000 Btu/h	≤ 55 gal		EF ≥ 0.67, FHR ≥ 67 gal	DOE 10 CFR Part 430
		> 55 gal		EF ≥ 0.77, FHR ≥ 67 gal	
	≤ 75,000 Btu/h	≤ 140 gal		E_t ≥ 0.94 or EF ≥ 0.93 and SL ≤ 0.84 × (Q/800 + 110√V), Btu/h	ANSI Z21.10.3
Gas instantaneous water heaters	> 50,000 Btu/h and < 200,000 Btu/h[d]	≥ 4,000 (Btu/h)/gal and < 2 gal		EF ≥ 0.90 and GPM ≥ 2.5 over a 77°F rise	DOE 10 CFR Part 430
	≥ 75,000 Btu/h[c]	≤ 140 gal ≥ 4,000 (Btu/h)/gal		E_t ≥ 0.94 or EF ≥ 0.93 SL = 0.84 × (Q/800 + 110√V), Btu/h	ANSI Z21.10.3
Oil storage water heaters	≤ 105,000 Btu/h	≤ 50 gal	Very small	EF = 0.2509 – 0.0012V	DOE 10 CFR Part 430
			Low	EF = 0.5330 – 0.0016V	
			Medium	EF = 0.6078 – 0.0016V	
			High	EF = 0.6815 – 0.0014V	
	> 105,000 Btu/h	< 4,000 (Btu/h)/gal		E_t ≥ 80% and SL ≤ (Q/800 + 110√V), Btu/h	ANSI Z21.10.3
Oil instantaneous water heaters	≤ 210,000 Btu/h	≤ 50 gal		EF ≥ 0.59 – 0.0019V	DOE 10 CFR Part 430
	> 210,000 Btu/h	≥ 4,000 (Btu/h)/gal and < 10 gal		E_t≥ 80%	ANSI Z21.10.3
	> 210,000 Btu/h	≥ 4,000 (Btu/h)/gal and < 10 gal		E_t ≥ 78% and SL ≤ (Q/800 + 110√V), Btu/h	
Solar water heater		Electric backup		SEF ≤ 1.8	ANSI Z21.10.3
		Gas backup		SEF ≤ 1.2	
Hot-water supply boilers, gas and oil	> 300,000 Btu/h and ≤ 12,500,000 Btu/h	≥ 4,000 (Btu/h)/gal and < 10 gal		E_t ≥ 80%	ANSI Z21.10.3
Hot-water supply boilers, gas		≥ 4,000 (Btu/h)/gal and ≥ 10 gal		E_t ≥ 80% SL ≤ (Q/800 + 110√V), Btu/h	ANSI Z21.10.3
Hot-water supply boilers, oil		≥ 4,000 (Btu/h)/gal and ≥ 10 gal		E_t ≥ 78% SL ≤ (Q/800 + 110√V), Btu/h	
Pool heaters, gas	All sizes			E_t ≥ 82%	ASHRAE 146
Pool heaters, oil	All sizes			E_t ≥ 78%	ASHRAE 146
Heat-pump pool heaters	All sizes	50°F db 44.2°F wb outdoor air 80.0°F entering water		≥ 4.0 COP	AHRI 1180
Unfired storage tanks	All sizes			≥ R-12.5	None

a. Energy factor (EF) and thermal efficiency (E_t) are minimum requirements, while standby loss (SL) is maximum Btu/h based on a 70°F temperature difference between stored water and ambient requirements. In the EF equation, V is the rated volume in gallons. In the SL equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h.

b. Chapter 11 (Section 11) contains details on the referenced test procedures, including the year/version of the referenced test procedure.

c. Section G.1 is titled "Test Method for Measuring Thermal Efficiency," and Section G.2 is titled "Test Method for Measuring Standby Loss."

d. UEF is the Uniform Energy Factor and is a dimensionless number that is calculated per DOE 10 CFR Part 430 test procedures.

TABLE B101.9 (TABLE B-9)
COMMERCIAL CLOTHES WASHERS (I-P)

PRODUCT	MEF[a]	WF[b], gal/ft^3
All commercial clothes washers	1.72	4.0

a. MEF = modified energy factor, a combination of energy factor and remaining moisture content. MEF measures energy consumption of the total laundry cycle (washing and drying). It indicates how many cubic feet of laundry can be washed and dried with one kWh of electricity; the higher the number, the greater the efficiency.

b. *WF = water factor* (in gal/ft^3).

TABLE B101.10 (TABLE B-10)
(SUPERSEDES TABLE 6.8.1-9 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW (VRF) AIR CONDITIONERS—MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
VRF air conditioners, air cooled	< 65,000 Btu/h	All	VRF multisplit system	15.0 SEER 12.5 EER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	VRF multisplit system	11.7 EER 14.9 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	11.7 EER 14.4 IEER	
	≥ 240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	10.5 EER 13.0 IEER	

a. Chapter 11 (Section 11) contains details for the referenced test procedure, including year version of the test procedure.

TABLE B101.11 (TABLE B-11)
(SUPERSEDES TABLE 6.8.1-10 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AND APPLIED HEAT PUMP —MINIMUM EFFICIENCY REQUIREMENTS (I-P)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
VRF air cooled (cooling mode)	< 65,000 Btu/h	All	VRF multisplit system	15.0 SEER 12.5 EER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	VRF multisplit system	11.3 EER 14.6 IEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	VRF multisplit system with heat recovery	11.1 EER 14.4 IEER	

	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	10.9 EER 13.9 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	VRF multisplit system with heat recovery	10.7 EER 13.7 IEER	
	≥ 240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	10.3 EER 12.7 IEER	
	≥ 240,000 Btu/h	Electric resistance (or none)	VRF multisplit system with heat recovery	10.1 EER 12.5 IEER	
VRF water source (cooling mode)	< 65,000 Btu/h	All	VRF multisplit systems 86°F entering water	14.0 EER 16.0 IEER	AHRI 1230
	< 65,000 Btu/h	All	VRF multisplit systems with heat recovery 86°F entering water	13.8 EER 15.8 IEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF multisplit system 86°F entering water	14.0 EER 16.0 IEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF multisplit system with heat recovery 86°F entering water	13.8 EER 15.8 IEER	
	≥ 135,000 Btu/h	All	VRF multisplit system 86°F entering water	11.6 EER 14.0 IEER	
	≥ 135,000 Btu/h	All	VRF multisplit system with heat recovery 86°F entering water	11.2 EER 13.8 IEER	
VRF groundwater source (cooling mode)	< 135,000 Btu/h	All	VRF multisplit system 59°F entering water	16.2 EER	AHRI 1230
	< 135,000 Btu/h	All	VRF multisplit system with heat recovery 59°F entering water	16.0 EER	
	≥ 135,000 Btu/h	All	VRF multisplit system 59°F entering water	13.8 EER	
	≥ 135,000 Btu/h	All	VRF multisplit system with heat recovery 59°F entering water	13.6 EER	
VRF ground source (cooling mode)	< 135,000 Btu/h	All	VRF multisplit system 77°F entering water	13.4 EER	AHRI 1230
	< 135,000 Btu/h	All	VRF multisplit system with heat recovery 77°F entering water	13.2 EER	
	≥ 135,000 Btu/h	All	VRF multisplit system 77°F entering water	11.0 EER	
	≥ 135,000 Btu/h	All	VRF multisplit system with heat recovery 77°F entering water	10.8 EER	
VRF air cooled (heating mode)	< 65,000 Btu/h (cooling capacity)		VRF multisplit system	8.5 HSPF	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)		VRF multisplit system 47°F db/43°F wb *outdoor air*	3.40 COP_H	
			17°F db/15°F wb *outdoor air*	2.40 COP_H	
	≥ 135,000 Btu/h (cooling capacity)		VRF multisplit system 47°F db/43°F wb *outdoor air*	3.20 COP_H	
			17°F db/15°F wb *outdoor air*	2.10 COP_H	
VRF water source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF multisplit system 68°F entering water	4.60 COP_H	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF multisplit system 68°F entering water	4.20 COP_H	
VRF groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF multisplit system 50°F entering water	3.60 COP_H	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF multisplit system 50°F entering water	3.30 COP_H	
VRF ground source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF multisplit system 32°F entering fluid	3.10 COP_H	AHRI 1230
	≥ 135,000 Btu/h (cooling capacity)		VRF multisplit system 32°F entering fluid	2.80 COP_H	

a. Chapter 11 (Section 11) contains details for the referenced test procedure, including year version of the test procedure.

TABLE B101.1 (TABLE B-1)
(SUPERSEDES TABLE 6.8.1-1 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS—MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITIONS	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air conditioners, air cooled	< 19 kW (one phase)	All	Split systems	4.40 $SCOP_C$ 3.66 COP_C	AHRI 210/240
			Single packaged	4.40 $SCOP_C$ 3.52 COP_C	

	< 19 kW (three phase)	All	Split systems	4.40 $SCOP_C$ 3.52 COP_C	
			Single packaged	4.10 $SCOP_C$ 3.40 COP_C	
Through-the-*wall*, air cooled	< 9 kW	All	Split systems	3.52 $SCOP_C$	
			Single packaged	3.52 $SCOP_C$	
Small duct, high velocity, air cooled	< 19 kW (one phase)	All	Split systems	3.52 $SCOP_C$	
	< 19 kW (three phase)	All	Split systems	3.52 $SCOP_C$	
Air conditioners air cooled	≥ 19 kW and < 40 kW	Electric resistance (or none)	Split systems and single package	3.58 COP_C 4.10 $ICOP_C$	ARI 340/360
		All other	Split systems and single package	3.52 COP_C 4.04 $ICOP_C$	
	≥ 40 kW and < 70 kW	Electric resistance (or none)	Split systems and single package	3.58 COP_C 3.87 $ICOP_C$	
		All other	Split systems and single package	3.52 COP_C 3.81 $ICOP_C$	
	≥ 70 kW and < 223 kW	Electric resistance (or none)	Split systems and single package	3.17 COP_C 3.60 $ICOP_C$	
		All other	Split systems and single package	3.11 COP_C 3.55 $ICOP_C$	
	≥ 223 kW	Electric resistance (or none)	Split systems and single package	3.05 COP_C 3.40 $ICOP_C$	
		All other	Split systems and single package	2.99 COP_C 3.34 $ICOP_C$	
Air conditioners, water cooled	< 19 kW	All	Split systems and single package	4.10 COP_C	AHRI 210/240
			Split systems and single package	4.48 $ICOP_C$	
	≥ 19 kW and < 140 kW	Electric resistance (or none)	Split systems and single package	4.10 COP_C 4.48 $ICOP_C$	AHRI 340/360
		All other	Split systems and single package	4.04 COP_C 4.43 $ICOP_C$	
	≥ 40 kW and < 70 kW	Electric resistance (or none)	Split systems and single package	4.10 COP_C 4.34 $ICOP_C$	
		All other	Split systems and single package	4.04 COP_C 4.28 $ICOP_C$	
	≥ 70 kW and < 223 kW	Electric resistance (or none)	Split systems and single package	4.10 COP_C 4.34 $ICOP_C$	
		All other	Split systems and single package	3.99 COP_C 4.28 $ICOP_C$	
	≥ 223 kW	Electric resistance (or none)	Split systems and single package	4.10 COP_C 4.34 $ICOP_C$	
		All other	Split systems and single package	4.04 COP_C 4.28 $ICOP_C$	
Air conditioners, evaporatively cooled	< 19 kW	All	Split systems and single package	4.10 COP_C 4.48 $ICOP_C$	AHRI 210/240
	≥ 19 kW and < 140 kW	Electric resistance (or none)	Split systems and single package	4.10 COP_C 4.48 $ICOP_C$	AHRI 340/360
		All other	Split systems and single package	4.04 COP_C 4.43 $ICOP_C$	
	≥ 40 kW and < 70 kW	Electric resistance (or none)	Split systems and single package	3.96 COP_C 4.19 $ICOP_C$	
		All other	Split systems and single package	3.90 COP_C 4.13 $ICOP_C$	
	≥ 70 kW and < 223 kW	Electric resistance (or none)	Split systems and single package	3.96 COP_C 4.19 $ICOP_C$	
		All other	Split systems and single package	3.90 COP_C 4.13 $ICOP_C$	
	≥ 223 kW	Electric resistance (or none)	Split systems and single package	3.96 COP_C 4.19 $ICOP_C$	
		All other	Split systems and single package	3.90 COP_C 4.13 $ICOP_C$	
Condensing units, air cooled	≥ 40 kW			Not applicable match with indoor coil	AHRI 365
Condensing, water or evaporatively cooled	40 kW			Not applicable match with indoor coil	

a. Chapter 11 (Section 11) contains a details on the referenced test procedures, including year and version of the test procedure.

TABLE B101.2 (TABLE B-2)
(SUPERSEDES TABLE 6.8.1-2 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITIONS	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Air conditioners, air cooled (cooling mode)	< 19 kW (one phase)	All	Split systems	4.40 $SCOP_C$ 3.66 COP_C	AHRI 210/240
			Single packaged	4.40 $SCOP_C$	

				3.52 COP_C	
	< 19 kW (three phase)	All	Split systems	4.40 $SCOP_C$ 3.66 COP_C	
			Single packaged	4.40 $SCOP_C$ 3.52 COP_C	
Through-the-*wall*, air cooled (cooling mode)	< 9 kW	All	Split systems	3.52 $SCOP_C$	
			Single packaged	3.52 $SCOP_C$	
Small duct high velocity, air cooled (cooling mode)	< 19 kW (one phase)	All	Split systems	3.52 $SCOP_C$	
	< 19 kW (three phase)	All	Split systems	3.52 $SCOP_C$	
Air conditioners, air cooled (cooling mode)	≥ 19 kW and < 40 kW	Electric resistance (or none)	Split systems and single package	3.31 COP_C 3.60 $ICOP_C$	AHRI 340/360
		All other	Split systems and single package	3.25 COP_C 3.55 $ICOP_C$	
	≥ 40 kW and < 70 kW	Electric resistance (or none)	Split systems and single package	3.19 COP_C 3.40 $ICOP_C$	
		All other	Split systems and single package	3.14 COP_C 3.34 $ICOP_C$	
	≥ 70 kW	Electric resistance (or none)	Split systems and single package	3.02 COP_C 3.11 $ICOP_C$	
		All other	Split systems and single package	2.96 COP_C 3.05 $ICOP_C$	
Water-to-air water loop (cooling mode)	< 5 kW	All	30°C entering water	4.10 COP_C	ISO-13256-1
	≥ 5 kW and < 19kW	All	30°C entering water	4.10 COP_C	
	> 19kW and < 40kW	All	30°C entering water	4.10 COP_C	
Water-to-air ground water (cooling mode)	< 40 kW	All	15°C entering water	5.28 COP_C	
Water-to-air ground loop (cooling mode)	< 40 kW	All	25°C entering water	4.13 COP_C	
Water-to-water water loop (cooling mode)	< 40 kW	All	30°C entering water	3.11 COP_C	ISO-13256-2
Water-to-water groundwater (cooling mode)	< 40 kW	All	15°C entering water	4.78 COP_C	
Brine-to-water ground loop (cooling mode)	< 40 kW	All	30°C entering water	3.55 COP_C	
Air conditioners, air cooled (heating mode)	< 19 kW (cooling capacity) (one phase)	All	Split systems	2.49 COP_H	AHRI 210/240
			Single packaged	2.40 COP_H	
	< 19 kW (cooling capacity) (three phase)	All	Split systems	2.49 COP_H	
			Single packaged	2.40 COP_H	
Through-the-*wall*, air cooled (heating mode)	< 9 kW (cooling capacity)	All	Split systems	2.17 COP_H	AHRI 210/240
			Single packaged	2.17 COP_H	
Small-duct high velocity, air cooled (heating mode)	< 19 kW (cooling capacity) (one phase)	All	Split systems	2.11 COP_H	
	< 19 kW (cooling capacity) (three phase)	All	Split systems	2.11 COP_H	
Air cooled (heating mode)	≥ 19 kW and < 40 kW (cooling capacity)		8.3°C db/6.1°C wb *outdoor air*	3.40 COP_H	AHRI 340/360
			–8.3°C db/9.4°C wb *outdoor air*	2.40 COP_H	
	≥ 40 kW (cooling capacity)		8.3°C db/6.1°C wb *outdoor air*	3.20 COP_H	
			–8.3°C db/9.4°C wb *outdoor air*	2.10 COP_H	
Water-to-air water loop (heating mode)	< 40 kW (cooling capacity)		20°C entering water	4.60 COP_H	ISO-13256-1
Water-to-air groundwater (heating mode)	< 40 kW (cooling capacity)		10°C entering water	3.70 COP_H	
Brine-to-air ground loop (heating mode)	< 40 kW (cooling capacity)		0°C entering fluid	3.20 COP_H	
Water-to-water water loop (heating mode)	< 40 kW (cooling capacity)		20°C entering water	3.70 COP_H	ISO-13256-2
Water-to-water groundwater (heating mode)	< 40 kW (cooling capacity)		10°C entering water	3.10 COP_H	
Brine-to-water ground loop (heating mode)	< 40 kW (cooling capacity)		0°C entering fluid	2.50 COP_H	

a. Chapter 11 (Section 11) contains details on the referenced test procedures, including year and version of the test procedure.

TABLE B101.3 (TABLE B-3)
(SUPERSEDES TABLE 6.8.1-4 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED SINGLE-PACKAGED VERTICAL AIR CONDITIONERS AND SINGLE-PACKAGED VERTICAL HEAT PUMPS AIR-CONDITIONER HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
PTAC (cooling mode) standard size	All capacities	35°C db *outdoor air*	4.22-(0.300 × Cap/1000)[c] COP_C	AHRI 310/380
PTAC (cooling mode) nonstandard size[b]	All capacities	35°C db *outdoor air*	3.19-(0.213 × Cap/1000)[c] COP_C	AHRI 310/380
PTHP (cooling mode) standard size	All capacities	35°C db *outdoor air*	4.22-(0.300 × Cap/1000)[c] COP_C	AHRI 310/380

PTHP (cooling mode) nonstandard size[b]	< 7,000 Btu/h	35°C db *outdoor air*	3.16-(0.213 × Cap/1000)[c] COP_C	AHRI 310/380
PTHP (heating mode) new constructions	All capacities	8.3°C db/6.1°C wb *outdoor air*	3.7-(0.052 × Cap/1000)[c] COP_H	AHRI 310/380
PTHP (heating mode) nonstandard size[b]	All capacities	8.3°C db/6.1°C wb *outdoor air*	2.9-(0.026 × Cap/1000)[c] COP_H	AHRI 310/380

a. Chapter 11 (Section 11) contains a complete specification of the referenced test procedures, including year version of the test procedure.

b. Replacement units shall be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 0.45 m. high and less than 1.0 m. wide and having a cross-sectional area less than 0.43 m^2.

c. "Cap" means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 2.1 kW, use 2.1 kW in the calculation. If the unit's capacity is greater than 4.4 kW, use 4.4 kW in the calculation.

TABLE B101.4 (TABLE B-4)

(SUPERSEDES TABLE 6.8.1-4 IN ANSI/ASHRAE/IES STANDARD 90.1) SINGLE-PACKAGED VERTICAL AIR CONDITIONERS, SINGLE-PACKAGED VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS, AND ROOM AIR-CONDITIONER HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY BASE	MINIMUM EFFICIENCY CONNECTED[b]	TEST PROCEDURE[a]
SPVAC (cooling mode)	< 19 kW	35°C db/23.9°C wb *outdoor air*	4.10 $SCOP_C$		AHRI 210/240
	≥ 19 kW and < 40 kW	35°C db/23.9°C wb *outdoor air*	3.28 COP_C 3.78 $ICOP_C$		AHRI 340/360
	≥ 40 kW and < 70 kW	35°C db/23.9°C wb *outdoor air*	3.22 COP_C 3.63 $ICOP_C$		
SPVHP (cooling mode)	< 19 kW	35°C db/23.9°C wb *outdoor air*	4.10 $SCOP_C$		AHRI 210/240
	≥ 19 kW and < 40 kW	35°C db/23.9°C wb *outdoor air*	3.22 COP_C 3.58 $ICOP_C$		AHRI 340/360
	≥ 40 kW and < 70 kW	35°C db/23.9°C wb *outdoor air*	3.11 COP_C 3.40 $ICOP_C$		
SPVHP (heating mode)	< 19 kW	8.3°C db/6.1°C wb *outdoor air*	2.34 $SCOP_H$		AHRI 210/240
	≥ 19 kW and < 40 kW	8.3°C db/6.1°C wb *outdoor air*	3.30 COP_H		AHRI 340/360
	≥ 40 kW and < 70 kW	8.3°C db/6.1°C wb *outdoor air*	3.2 COP_H		
Room air conditioners, with louvered sides	< 1.8 kW		3.55 $CCOP_C$	3.37 $CCOP_C$	ANSI/AHAM RAC-1
	≥ 1.8 kW and < 2.3kW		3.55 $CCOP_C$	3.37 $CCOP_C$	
	≥ 2.3 kW and < 4.1kW		3.52 $CCOP_C$	3.37 $CCOP_C$	
	≥ 4.1 kW and < 5.9kW		3.46 $CCOP_C$	3.28 $CCOP_C$	
	≥ 5.9 kW and < 8.2kW		3.02 $CCOP_C$	2.87 $CCOP_C$	
	≥ 8.2 kW		2.90 $CCOP_C$	2.75 $CCOP_C$	
Room air conditioners, without louvered sides	< 1.8 kW		3.22 $CCOP_C$	3.08 $CCOP_C$	
	≥ 1.8kW and < 2.3 kW		3.22 $CCOP_C$	3.08 $CCOP_C$	
	≥ 2.3kW and < 3.2 kW		3.11 $CCOP_C$	2.96 $CCOP_C$	
	≥ 3.2kW and < 4.1 kW		3.08 $CCOP_C$	2.93 $CCOP_C$	
	≥ 4.1kW and < 5.9 kW		2.99 $CCOP_C$	2.84 $CCOP_C$	
	≥ 5.9 kW		3.02 $CCOP_C$	2.87 $CCOP_C$	
Room air conditioner heat pump, with louvered sides	< 5.9 kW		3.17 $CCOP_C$	3.02 $CCOP_C$	
	≥ 5.9 kW		2.99 $CCOP_C$	2.84 $CCOP_C$	
Room air conditioner heat pump, without louvered sides	< 4.1 kW		2.99 $CCOP_C$	2.84 $CCOP_C$	
	≥ 4.1 kW		2.81 $CCOP_C$	2.67 $CCOP_C$	
Room air conditioner, casement only	All capacities		3.08 $CCOP_C$	2.93 $CCOP_C$	
Room air conditioner, casement-slider	All capacities		3.34 $CCOP_C$	3.17 $CCOP_C$	

a. Chapter 11 (Section 11) contains details for the referenced test procedure, including the referenced year version of the test procedure.

b. Connected room air conditioners that are connected to utility programs are allowed a lower *CEER* value but must be in compliance with and certified per ENERGY STAR version 4.0 requirements for connected equipment.

TABLE B101.5 (TABLE B-5)

(SUPERSEDES TABLE 6.8.1-5 IN ANSI/ASHRAE/IES STANDARD 90.1) WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES, AND UNIT HEATERS—MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE	SIZE CATEGORY(INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
Warm-air furnace, gas fired (weatherized)	< 65.9 kW	Maximum capacity[c]	78% AFUE or 80% E_t[b,d]	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 65.9 kW		80% E_t[d]	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-air furnace, gas fired (nonweatherized)	< 65.9 kW	Maximum capacity[c]	90% AFUE or 92% E_t[b,d]	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 65.9 kW		92% E_t[d]	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-air furnace, oil fired (weatherized)	< 65.9 kW	Maximum capacity[c]	78% AFUE or 80% E_t[b,d]	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥ 65.9 kW		81% E_t[d]	Section 42, Combustion, UL 727
Warm-air furnace, oil fired (nonweatherized)	< 65.9 kW	Maximum capacity[c]	85% AFUE or 87% E_t[b,d]	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727

	≥ 65.9 kW		87% E_t[d]	Section 42, Combustion, UL 727
Warm-air duct furnaces, gas fired (weatherized)	All capacities	Maximum capacity[c]	80% E_c[e]	Section 2.10, Efficiency, ANSI Z83.8
Warm-air duct furnaces, gas fired (nonweatherized)	All capacities	Maximum capacity[c]	90% E_c[e]	Section 2.10, Efficiency, ANSI Z83.8
Warm-air unit heaters, gas fired (nonweatherized)	All capacities	Maximum capacity[c]	80% E_c[e,f]	Section 2.10, Efficiency, ANSI Z83.8
Warm-air unit heaters, oil fired (weatherized)	All capacities	Maximum capacity[c]	90% E_c[e,f]	Section 40, Combustion, UL 731

a. Chapter 11 (Section 11) contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

b. Combination units not covered by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430 (three-phase power or cooling capacity greater than or equal to 19 kW) may comply with either rating.

c. Compliance of multiple firing rate units shall be at the maximum firing rate.

d. E_t = thermal *efficiency*. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75% of the input rating, and have either power venting or a *flue damper*. A *vent damper* is an acceptable alternative to a *flue damper* for those furnaces where combustion air is drawn from the *conditioned space*.

e. E_c = combustion *efficiency* (100% less flue losses). See test procedure for detailed discussion.

f. As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an *automatic flue damper*.

TABLE B101.6 (TABLE B-6)
(SUPERSEDES TABLE 6.8.1-6 IN ANSI/ASHRAE/IES STANDARD 90.1) GAS- AND OIL-FIRED BOILERS—MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE[a]	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY[b,c]	TEST PROCEDURE[g]
Boilers, hot water	Gas fired	< 87.9 kW [h,i]	89% AFUE[f]	10 CFR Part 430
		≥ 87.9 kW and < 732.7 kW [d]	89% E_t[f]	10 CFR Part 431
		≥ 732.7 kW [a]	91% E_c[f]	
	Oil fired[e]	< 87.9 kW	89% AFUE[f]	10 CFR Part 430
		≥ 87.9 kW and < 732.7 kW [d]	85% E_t[f]	10 CFR Part 431
		≥ 732.7 kW [a]	86% E_c[f]	
Boilers, steam	Gas fired	< 87.9 kW [i]	80% AFUE	10 CFR Part 430
	Gas fired all except natural draft	≥ 87.9 kW and < 732.7 kW [d]	79% E_t	10 CFR Part 431
		≥ 732.7kW[a]	79% E_t	
	Gas fired natural draft	≥ 87.9 kW and < 732.7 kW [d]	77% E_t	
		≥ 732.7kW[a]	77% E_t	
	Oil fired[e]	< 87.9 kW	82% AFUE	10 CFR Part 430
		≥ 87.9 kW and < 732.7 kW [d]	81% E_t	10 CFR Part 431
		≥ 732.7 kW [a]	81% E_t	

a. These requirements apply to boilers with rated input of 2344 kW or less that are not packaged boilers, and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.

b. E_c = thermal efficiency (100% less flue losses). See reference document for detailed information.

c. E_t = thermal efficiency. See reference document for detailed information.

d. Maximum capacity—minimum and maximum ratings as provided for and allowed by the unit's controls.

e. Includes oil fired (residual).

f. Systems shall be designed with lower operating return hot-water temperatures (< 55°C) and use hot-water reset to take advantage of the higher efficiencies of condensing boilers.

g. Chapter 11 (Section 11) contains details for the referenced test procedure, including the referenced year version of the test procedure.

h. A boiler not equipped with a tankless domestic water-heating coil shall be equipped with an *automatic* means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.

i. Boilers shall not be equipped with a continuous pilot ignition system.

TABLE B101.7 (TABLE B-7)
(SUPERSEDES TABLE 6.8.1-7 IN ANSI/ASHRAE/IES STANDARD 90.1) PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT—MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITION[g]	PERFORMANCE REQUIRED[a,b,c,d,e,f,i]	TEST PROCEDURE[h]
Propeller or axial fan open-circuit cooling towers	All	35.0°C entering water 29.4°C leaving water 23.9°C entering wb	≥ 3.56 L/s kW	CTI ATC-105 and CTI STD-201RS
Centrifugal fan open-circuit cooling towers	All	35.0°C entering water 29.4°C leaving water 23.9°C entering wb	≥ 1.86 L/s kW	CTI ATC-105 and CTI STD-201RS
Propeller or axial fan closed-circuit cooling towers	All	38.9°C entering water 32.2°C leaving water 23.9°C entering wb	≥ 1.36 L/s kW	CTI ATC-105S and CTI STD-201RS
Centrifugal fan closed-circuit cooling towers	All	38.9°C entering water 32.2°C leaving water 23.9°C entering wb	≥ 0.68 L/s kW	CTI ATC-105S and CTI STD-201RS
Propeller or axial fan evaporative condensers	All	Ammonia test fluid 60.0°C entering gas temperature 35.7°C condensing temperature 23.9°C entering wb	≥ 52.6 COP	CTI ATC-106
Centrifugal fan evaporative condensers	All	Ammonia test fluid 60.0°C entering gas temperature 35.7°C condensing temperature 23.9°C entering wb	≥ 43.2 COP	CTI ATC-106
Propeller or axial fan evaporative condensers	All	R-507A test fluid 73.9°C entering gas temperature 40.6°C condensing temperature 23.9°C entering wb	≥ 61.7 COP	CTI ATC-106
Centrifugal fan evaporative condensers	All	R-507A test fluid	≥ 53.1 COP	CTI ATC-106

		73.9°C entering gas temperature 40.6°C condensing temperature 23.9°C entering wb		
Air-cooled condensers	All	88°C entering gas temperature 52°C condensing temperature 8°C subcooling 35°C entering wb	≥ 69 COP	AHRI 460

a. For purposes of this table, *open-circuit cooling tower performance* is defined as the water flow rating of the tower at the thermal rating condition listed in Table B101.8 (B-8) divided by the fan motor nameplate power.

b. For purposes of this table, *closed-circuit cooling tower performance* is defined as the process water flow rating of the tower at the thermal rating condition listed in Table B101.8 (B-8) divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.

c. For purposes of this table, *evaporative condenser performance* is defined as the heat rejected at the specified rating condition in the table divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power.

d. For purposes of this table, *air-cooled condenser performance* is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

e. The efficiencies and test procedures for both *open-* and *closed-circuit cooling towers* are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections. The certification requirements do not apply to field erected cooling towers.

f. All cooling towers, closed-circuit coolers, evaporative condensers and air-cooled condensers shall comply with the minimum efficiency listed in the table for that specific type of equipment with the capacity effect of any project specific accessories and/or options included with the equipment.

g. Requirements for evaporative condensers are listed with ammonia (R-717) and R-507A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-507A must meet the minimum efficiency requirements listed for R-507A as the test fluid.

h. Informative Appendix G contains information on the referenced test procedures.

i. Not applicable for air-cooled condensers applied to condenserless chillers. The air-cooled condenser and condenserless chiller shall comply with the requirements for air-cooled chillers as defined in ANSI/ASHRAE/IES Standard 90.1, Table 6.8.1-3.

TABLE B101.8 (TABLE B-8)
(SUPERSEDES TABLE 7.8 IN ANSI/ASHRAE/IES STANDARD 90.1) PERFORMANCE REQUIREMENTS FOR SERVICE WATER HEATING EQUIPMENT (SI)

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	RATED STORAGE VOLUME AND INPUT RATING (IF APPLICABLE)	DRAW PATTERN	PERFORMANCE REQUIRED[a,d]	TEST PROCEDURE[b]
Electric table-top water heaters[c]	≤ 12 kW	≥ 75.7 L and ≤ 454 L	Very small	UEF ≥ 0.6323 – 0.0015V	DOE 10 CFR Part 430
			Low	UEF ≥ 0.9188 – 0.00082V	
			Medium	UEF ≥ 0.9577 – 0.00061V	
			High	UEF ≥ 0.9844 – 0.00042V	
Electric resistance storage water heaters		≥ 75.7 L and ≤ 208 L	Very small	UEF ≥ 0.8808 – 0.00021V	DOE 10 CFR Part 430
			Low	UEF ≥ 0.9254 – 0.000079V	
			Medium	UEF ≥ 0.9307 – 0.000053V	
			High	UEF ≥ 0.9349 – 0.000026V	
		≥ 208 L		Must use heat-pump water heater	
Electric resistance grid-enabled water heaters		≥ 284 L	Very small	UEF ≥ 1.0136 – 0.00074V	DOE 10 CFR Part 430
			Low	UEF ≥ 0.09984 – 0.00037V	
			Medium	UEF ≥ 0.9853 – 0.00026V	
			High	UEF ≥ 0.9720 – 0.00018V	
Heat-pump water heaters		≤ 208 L		EF ≥ 2.00, FHR ≥ 190 L	DOE 10 CFR Part 430
		≥ 208 L		EF ≥ 2.20, FHR ≥ 190 L	
Gas-fired storage water heaters	≤ 22.0 kW	≤ 208 L		EF ≥ 0.67, FHR ≥ 250 L	DOE 10 CFR Part 430
		≥ 208 L		EF ≥ 0.77, FHR ≥ 250 L	
	≥ 22.0 kWh	≤ 208 L		E_t ≥ 0.94 or EF ≥ 0.93 SL = 0.84 × (Q/234 + 56.5√V), W	ANSI Z21.10.3
Gas instantaneous water heaters	> 14.6 kW and < 58.6 kW	≥ 309.7W/L and < 7.6 L		EF ≥ 0.90 and GPM ≥ 2.5 over a 25°C rise	DOE 10 CFR Part 430
	≥ 22.0 kW	≤ 530 L and ≥ 309.7W/L		E_t ≥ 0.94 or EF ≥ 0.93 SL = 0.84 × (Q/234 56.5 V), W)	ANSI Z21.10.3
Oil storage water heaters	≤ 30.7 kW	≤ 190L	Very small	EF = 0.2509 – 0.00032V	DOE 10 CFR Part 430
			Low	EF = 0.5330 – 0.00042V	
			Medium	EF = 0.6078 – 0.00042V	
			High	EF = 0.6815 – 0.0037V	
	≥ 30.7 kW	≤ 309.7 W/L		E_t ≥ 80% and SL ≤ (Q/234 + 56.5√V), W	ANSI Z21.10.3
Oil instantaneous water heaters	≤ 61.5 kW	≤ 190L		EF ≥ 0.59–0.00050V	DOE 10 CFR Part 430
	> 61.5 kW	≥ 309.7 W/L and < 38 L		E_t ≥ 80%	ANSI Z21.10.3
	> 61.5 kW	≥ 309.7 W/L and < 30 L		E_t ≥ 78% and SL ≤ (Q/234 + 56.5√V), W	
Solar water heater		Electric backup		SEF ≥ 1.8	ANSI Z21.10.3
		Gas backup		SEF ≥ 1.2	
Hot-water supply boilers, gas and oil	> 88 kW and ≤ 3660 kW	≥ 309.7 W/L and < 30 L		E_t ≥ 80%	ANSI Z21.10.3
Hot-water supply boilers, gas		≥ 309.7 W/L and < 30 L		E_t ≥ 78% and SL ≤ (Q/234 + 56.5√V), W	ANSI Z21.10.3
Hot-water supply boilers, oil		≥ 309.7 W/L and < 30 L		E_t ≥ 78% SL ≤ (Q/234 + 56.5√V), W	ANSI Z21.10.3
Pool heaters, gas	All sizes			E_t ≥ 82%	ASHRAE 146
Pool heaters, oil	All sizes			E_t ≥ 78%	ASHRAE 146
Heat-pump pool heaters	All sizes	10°C db 6.8°C wb *outdoor air* 26.7°C entering water		≥ 4.0 COP	ASHRAE 146
Unfired storage tanks	All sizes			≥ R-2.2°C • m^2/W	None

a. Energy factor (EF) and thermal efficiency (E_t) are minimum requirements, while standby loss (SL) is maximum W based on a 21°C temperature difference between stored water and ambient requirements. In the EF equation, *V* is the rated volume in litres. In the SL equation, *V* is the rated volume in litres and *Q* is the nameplate input rate in kW.

b. Chapter 11 (Section 11) contains details on the referenced test procedures, including the year/version of the referenced test procedure.

c. Section G.1 is titled "Test Method for Measuring Thermal Efficiency," and Section G.2 is titled "Test Method for Measuring Standby Loss."

d. UEF is the Uniform Energy Factor and is a dimensionless number that is calculated per DOE 10 CFR Part 430 test procedures.

TABLE B101.9 (TABLE B-9)
COMMERCIAL CLOTHES WASHERS (SI)

PRODUCT	MEF [a]	WF [b], L/L
All commercial clothes washers	48.7	0.53

a. MEF = modified energy factor, a combination of energy factor and remaining moisture content. MEF measures energy consumption of the total laundry cycle (washing and drying). It indicates how many liters of laundry can be washed and dried with one kWh of electricity; the higher the number, the greater the efficiency.

b. *WF = water factor* (in L/L).

TABLE B101.10 (TABLE B-10)
(SUPERSEDES TABLE 6.8.1-9 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW (VRF) AIR CONDITIONERS—MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
VRF air conditioners, air cooled	< 19 kW	All	VRF multisplit system	4.40 $SCOP_C$ 3.36 COP_C	AHRI 1230
	≥ 19 kW and < 40 kW	Electric resistance (or none)	VRF multisplit system	3.43 COP_C 4.37 $ICOP_C$	
	≥ 40 kW and < 70 kW	Electric resistance (or none)	VRF multisplit system	3.43 COP_C 4.22 $ICOP_C$	
	≥ 70 kW	Electric resistance (or none)	VRF multisplit system	3.08 COP_C 3.81 $ICOP_C$	

a. Chapter 11 (Section 11) contains details for the referenced test procedure, including year version of the test procedure.

TABLE B101.11 (TABLE B-11)
(SUPERSEDES TABLE 6.8.1-10 IN ANSI/ASHRAE/IES STANDARD 90.1) ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AND APPLIED HEAT PUMP —MINIMUM EFFICIENCY REQUIREMENTS (SI)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
VRF air cooled (cooling mode)	< 19 kW	All	VRF multisplit system	4.40 $SCOP_C$ 3.66 COP_C	AHRI 1230
	≥ 19 kW and < 40kW	Electric resistance (or none)	VRF multisplit system	3.31 COP_C 4.28 $ICOP_C$	
	≥ 19 kW and < 40kW	Electric resistance (or none)	VRF multisplit system with heat recovery	3.25 COP_C 4.22 $ICOP_C$	
	≥ 40 kW and < 70kW	Electric resistance (or none)	VRF multisplit system	3.19 COP_C 4.07 $ICOP_C$	
	≥ 40 kW and < 70kW	Electric resistance (or none)	VRF multisplit system with heat recovery	3.14 COP_C 4.02 $ICOP_C$	
	≥ 70 kW	Electric resistance (or none)	VRF multisplit system	3.02 COP_C 4.02 $ICOP_C$	
	≥ 70 kW	Electric resistance (or none)	VRF multisplit system with heat recovery	2.96 COP_C 3.66 $ICOP_C$	
VRF water source (cooling mode)	< 19 kW	All	VRF multisplit systems 30°C entering water	4.10 COP_C 4.69 $ICOP_C$	AHRI 1230
	< 19 kW	All	VRF multisplit systems with heat recovery 30°C entering water	4.04 COP_C 4.63 $ICOP_C$	
	≥ 19 kW and < 40kW	All	VRF multisplit system 30°C entering water	4.10 COP_C 4.69 $ICOP_C$	
	≥ 19 kW and < 40kW	All	VRF multisplit system with heat recovery 30°C entering water	4.04 COP_C 4.63 $ICOP_C$	
	≥ 40 kW	All	VRF multisplit system 30°C entering water	3.40 COP_C 4.10 $ICOP_C$	
	≥ 40kW	All	VRF multisplit system with heat recovery 30°C entering water	3.28 COP_C 4.04 $ICOP_C$	
VRF groundwater source (cooling mode)	< 40 kW	All	VRF multisplit system 15°C entering water	4.75 COP_C	AHRI 1230
	< 40 kW	All	VRF multisplit system with heat recovery 15°C entering water	4.69 COP_C	
	≥ 40 kW	All	VRF multisplit system 15°C entering water	4.04 COP_C	
	≥ 40 kW	All	VRF multisplit system with heat recovery 15°C entering	3.99 COP_C	
VRF ground source (cooling mode)	< 40 kW	All	VRF multisplit system 25°C entering water	3.93 COP_C	AHRI 1230
	< 40 kW	All	VRF multisplit system	3.87 COP_C	

			with heat recovery 25°C entering water		
	≥ 40 kW	All	VRF multisplit system 25°C entering water	3.22 COP_C	
	≥ 40 kW	All	VRF multisplit system with heat recovery 25°C entering water	3.17 COP_C	
VRF air cooled (heating mode)	< 19 kW (cooling capacity)		VRF multisplit system	2.49 $SCOP_H$	AHRI 1230
	≥ 19 kW and < 40kW (cooling capacity)		VRF multisplit system 8.3°C db/6.1°C wb outdoor air	3.40 COP_H	
			–8.3°C db/–9.4°C wb outdoor air	2.40 COP_H	
	≥ 40 kW (cooling capacity)		VRF multisplit system 8.3°C db/6.1°C wb outdoor air	3.20 COP_H	
			–8.3°C db/–9.4°C wb outdoor air	2.10 COP_H	
VRF water source (heating mode)	< 40 kW (cooling capacity)		VRF multisplit system 20°C entering water	4.60 COP_H	AHRI 1230
	≥ 40 kW (cooling capacity)		VRF multisplit system 20°C entering water	4.20 COP_H	
VRF groundwater source (heating mode)	< 40 kW (cooling capacity)		VRF multisplit system 10°C entering water	3.60 COP_H	AHRI 1230
	≥ 40 kW (cooling capacity)		VRF multisplit system 10°C entering water	3.30 COP_H	
VRF ground source (heating mode)	< 40 kW (cooling capacity)		VRF multisplit system 0°C entering fluid	3.10 COP_H	AHRI 1230
	≥ 40 kW (cooling capacity)		VRF multisplit system 0°C entering fluid	2.80 COP_H	

a. Chapter 11 (Section 11) contains a complete specification of the reference test procedure, including year version of the test procedure.

14_NORMATIVE APPENDIX C PERFORMANCE OPTION FOR ENERGY EFFICIENCY

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NORMATIVE APPENDIX C
PERFORMANCE OPTION FOR ENERGY EFFICIENCY

(This is a normative appendix and is part of this code.)

SECTION C101 (C1.)
GENERAL

C101.1 (C1.1) Renewable, Recovered, and Purchased Energy.

On-site renewable energy systems and *site* recovered energy: The modeling requirements for *on-site renewable energy systems* in the *proposed building performance* in ANSI/ASHRAE/IES Standard 90.1, Section G2.4.1, shall not apply and are superseded by Table C101.1 (C1.1), Section 15, "Renewable Energy Systems."

TABLE C101.1 (TABLE C1.1)
MODIFICATIONS AND ADDITIONS TO ANSI/ASHRAE/IES STANDARD 90.1, APPENDIX G, TABLE G3.1

PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1. Design Model No modifications	No modifications
2. Additions and Alterations No modifications	No modifications
3. Space Use Classification No modifications	No modifications
4. Schedules No modifications	No modifications
5. Building Envelope No modifications	No modifications
6. Lighting No modifications	No modifications
7. Thermal Blocks—HVAC Zones Designed No modifications	No modifications
8. Thermal Blocks—HVAC Zones Not Designed No modifications	No modifications
9. Thermal Blocks—Multifamily Residential Buildings No modifications	No modifications
10. HVAC Systems No modifications	No modifications
11. Service Hot-Water Systems No modifications	No modifications
12. Receptacle and Other Loads No modifications	No modifications
13. Modeling Limitations to the Simulation Program No modifications	No modifications
14. Exterior Conditions No modifications	No modifications
15. On-Site Renewable Energy Systems The reduction in the *proposed building performance* and annual CO_2e of the *proposed design* due to energy generated by *on-site renewable energy systems* shall be calculated as follows: a. **Annual Energy Cost.** The annual energy cost of the *proposed design* with an *on-site renewable energy system* shall be calculated on an hourly basis and adjusted as follows: 1. **Thermal Energy Performance Calculation.** The hourly thermal loads of the *proposed design* shall be reduced by the hourly thermal energy production of the *on-site renewable energy system* (but thermal loads shall not be reduced to less than zero). When the on-site renewable thermal energy production exceeds the applicable thermal demands of the building for any hour, the excess generated energy may be used to displace thermal loads at other times, provided the system has the storage capability and storage losses are included in the calculation. The approved energy rate structure shall be applied to the reduced energy consumption. 2. **Electric Energy Performance Calculation.** The total electrical energy production of the *on-site renewable energy system* shall be calculated on an hourly basis, and the energy cost of the *proposed building performance* shall be calculated by applying the approved electrical rate structure to each hour's electrical usage, including any reduction from hourly electrical energy production of the *on-site renewable energy system*. **Exception:** For *building projects* with no net metering agreement, feed-in tariff, or other electrical rate structure for net generated electricity, the cost of imported electricity from the grid is calculated by applying the approved electrical rate structure to each hour's electrical loads minus the hourly electrical energy production of the *on-site renewable energy system*, but the cost of imported electricity shall not be less than zero on a monthly basis. Electricity production of the *on-site renewable energy system* that has a retail value in excess of the retail cost of electricity consumption on a monthly basis shall be credited as a reduction in energy costs to the *building performance* at the wholesale rate as follows: $$\text{Credit} = \frac{(\text{ExRR} - \text{ImRR})}{\text{ExRR}} \times \text{ExkWh} \times \text{WR}$$ **where:** **Credit = cost reduction credit for month where retail value of exported electricity is greater than retail value of imported electricity.** **ExRR = month's value of exported electricity at retail rate.** **ImRR = month's value of imported electricity at retail rate.** **ExkWh = total kilowatt-hours exported in month.** **WR = average monthly wholesale rate for the region where the building located.**	

b. **Annual CO_2e.** The annual CO_2e of the proposed building that includes an *on-site renewable energy system* shall be equal to the annual CO_2e of the imported energy to serve the proposed building (with reduced loads due to the *on-site renewable energy system*) minus the annual exported electricity produced by the *on-site renewable energy system* multiplied by the electrical CO_2e emission factor.

Documentation: The documentation required in ANSI/ASHRAE/IES Standard 90.1, Section G2.5 (a), (b), and (e), shall be made available to the *AHJ*, upon request, for all *on-site renewable energy systems* in the *proposed design*.

C101.2 (C1.2) Building Performance Calculations.

In addition to the requirements of ANSI/ASHRAE/IES Standard 90.1, Table G3.1, the *proposed design* shall comply with all modifications and additions in Table C101.1 (C1.1). All references to Table G3.1 in Table C101.1 (C1.1) refer to ANSI/ASHRAE/IES Standard 90.1, Appendix G, Table G3.1.

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(First Printing: Sep 2018)

NORMATIVE APPENDIX D
BUILDING CONCENTRATIONS

(This is a normative appendix and is part of this code.)

SECTION D101 (D1.)
BUILDING CONCENTRATIONS

Building concentrations shall be estimated based on the following parameters and criteria:

a. Laboratory-measured volatile organic compound (VOC) emission factors and actual surface area of all materials as described in (b) below.

b. At minimum, those materials listed in Section 801.5.2(a) through (g) [8.5.2(a) through (g)] to be installed shall be modeled.

c. The actual building parameters for volume, average weekly minimum ventilation rate, and ventilated volume fraction for the building being modeled shall be used.

d. Standard building scenarios or modeling from similar buildings shall not be allowed.

e. Average weekly minimum air change rates shall be calculated based on the *minimum outdoor airflow* and hours of operation for the specific building being modeled.

f. Steady-state conditions with respect to emission rates and building ventilation may be assumed.

g. Zero *outdoor air* concentrations, perfect mixing within the building, and no net losses of VOCs from air due to other effects such as irreversible or net sorption on surfaces (i.e., net sink effects) and chemical reactions may be assumed.

h. All assumptions shall be clearly stated in the design documents.

i. The estimated building concentration C_{Bi} (µg/m^3) of each target VOC shall be calculated using Equation 2 of CDPH/EHLB/Standard Method V1.1 (commonly referred to as California Section 01350), as shown below. Estimated building concentrations of individual target VOCs with multiple sources shall be added to establish a single total estimated building concentration for individual target VOCs.

$$C_{Bi} = (EF_{Ai} \times A_B)/(V_B \times a_B \times 0.9)$$

where:

EF_{Ai} = area specific emission rate or emission factor at 96 hours after placing a test specimen in the chamber (14 days total exposure time), µg/m^2·h.

A_B = exposed surface area of the installed material in the building, m^2.

V_B = building volume, m^3.

a_B = average weekly minimum air change rate, 1/h.

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INFORMATIVE APPENDIX E BUILDING ENVELOPE TABLES

(This appendix is not part of this code. It is merely informative and does not contain requirements necessary for conformance to the code. It has not been processed according to the ANSI requirements for a code and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

The first nine tables are in I-P units, followed by nine tables in SI units. U-factors, C-factors, F-factors, and *SHGC* in these tables meet the requirements of Section 701.4.2.1 (7.4.2.1), although the R-values in most cases provide more insulation than is required in Section 701.4.2.1 (7.4.2.1). These R-values represent common assemblies in building construction. Assemblies with lower R-values are allowed to be used the meet the criteria of Section 701.4.2.1 (7.4.2.1) when they meet the appropriate U-factor, C-factor, or F-factor criteria.

TABLE E101.0 (TABLE E-0)
(SUPERSEDES TABLE 5.5-0 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 0 (A,B)* (I-P)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.039	R-25 c.i.	U-0.032	R-30 c.i.	U-0.218	R-3.8 c.i.
Metal building [a]	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.115	R-10
Attic and other roofs	U-0.027	R-38	U-0.027	R-38	U-0.081	R-13
Walls, above grade						
Mass [b]	U-0.580	NR	U-0.151	R-5.7 c.i.	U-0.580	NR
Metal building	U-0.094	R-0 + R-9.8 ci	U-0.094	R-0 + R-9.8. ci	U-0.352	NR
Steel framed	U-0.124	R-13	U-0.124	R-13	U-0.352	NR
Wood framed and other	U-0.089	R-13	U-0.089	R-13	U-0.292	NR
Wall, below grade						
Below-grade *wall*	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors						
Mass	U-0.322	NR	U-0.322	NR	U-0.322	NR
Steel joist	U-0.350	NR	U-0.350	NR	U-0.350	NR
Wood framed and other	U-0.282	NR	U-0.282	NR	U-0.282	NR
Slab-on-grade floors						
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
Heated	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.
Opaque doors						
Swinging	U-0.370		U-0.370		U-0.700	
Nonswinging	U-0.310		U-0.310		U-1.450	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX.U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing (all)	U-0.30	E&W-0.21, N&S-0.22	1.10	U-0.30	E&W-0.21, N&S-0.22	1.10	U-0.88	NR	NR
Metal framing, fixed	U-0.48			U-0.48			U-1.14		
Metal framing, operable	U-0.62			U-0.62			U-1.14		
Metal framing, entrance door	U-0.79			U-0.79			U-1.05		
Skylight, 0% to 3% of *roof*									
All types	U-0.71	0.33	NR	U-0.71	0.33	NR	U-1.71	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; FC = filled cavity (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.5).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

b. Exception applies for mass *walls* above grade where the requirement is for a maximum assembly U-0.151 (see ANSI/ASHRAE/IES Standard 90.1, Section 5.5.3.2).

TABLE E101.1 (TABLE E-1)
(SUPERSEDES TABLE 5.5-1 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 1 (A,B)* (I-P)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.048	R-20 c.i.	U-0.039	R-25 c.i.	U-0.218	R-3.8 c.i.
Metal building [a]	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.115	R-10
Attic and other roofs	U-0.027	R-38	U-0.027	R-38	U-0.081	R-13

Walls, above grade								
Mass [b]	U-0.580	NR		U-0.151	R-5.7 c.i.		U-0.580	NR	
Metal building	U-0.094	R-0 + R-9.8 c.i.		U-0.094	R-0 + R-9.8. c.i.		U-0.352	NR	
Steel framed	U-0.124	R-13		U-0.124	R-13		U-0.352	NR	
Wood framed and other	U-0.089	R-13		U-0.089	R-13		U-0.292	NR	
Wall, below grade								
Below-grade *wall*	C-1.140	NR		C-1.140	NR		C-1.140	NR	
Floors								
Mass	U-0.322	NR		U-0.322	NR		U-0.322	NR	
Steel joist	U-0.350	NR		U-0.350	NR		U-0.350	NR	
Wood framed and other	U-0.282	NR		U-0.282	NR		U-0.282	NR	
Slab-on-grade floors								
Unheated	F-0.730	NR		F-0.730	NR		F-0.730	NR	
Heated	F-1.020	R-7.5 for 12 in.		F-1.020	R-7.5 for 12 in.		F-1.020	R-7.5 for 12 in.	
Opaque doors								
Swinging	U-0.370			U-0.370			U-0.700		
Nonswinging	U-0.310			U-0.310			U-1.450		
FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.48	E&W-0.24, S-0.25, N-0.35	1.10	U-0.48	E&W-0.24, S-0.25, N-0.35	1.10	U-0.88	NR	NR
Metal framing, fixed	U-0.54			U-0.54			U-1.14		
Metal framing, operable	U-0.62			U-0.62			U-1.14		
Metal framing, entrance door	U-1.05			U-1.05			U-1.05		
Skylight, 0% to 3% of *roof*									
All types	U-0.71	0.33	NR	U-0.71	0.33	NR	U-1.71	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; FC = filled cavity (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.5).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

b. Exception applies for mass *walls* above grade where the requirement is for a maximum assembly U-0.151 (see ANSI/ASHRAE/IES Standard 90.1, Section 5.5.3.2).

TABLE E101.2 (TABLE E-2)
(SUPERSEDES TABLE 5.5-2 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 2 (A,B)* (I-P)

OPAQUE ELEMENTS	**NONRESIDENTIAL**		**RESIDENTIAL**		**SEMIHEATED**	
	ASSEMBLY MAXIMUM	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****
Roofs						
Insulation entirely above deck	U-0.039	R-25 c.i.	U-0.039	R-25 c.i.	U-0.173	R-5 c.i.
Metal building [a]	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.096	R-16
Attic and other roofs	U-0.027	R-38	U-0.027	R-38	U-0.053	R-19
Walls, above grade						
Mass[b]	U-0.151	R-5.7 c.i.	U-0.123	R-7.6 c.i.	U-0.580	NR
Metal building	U-0.094	R-0 + R-9.8 c.i.	U-0.094	R-0 + R-9.8 c.i.	U-0.162	R-13
Steel framed	U-0.084	R-13 + R-3.8 c.i.	U-0.064	R-13 + R-7.5 c.i.	U-0.124	R-13
Wood framed and other	U-0.089	R-13	U-0.089	R-13	U-0.089	R-13
Wall, below grade						
Below-grade *wall*	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors						
Mass	U-0.107	R-6.3 c.i.	U-0.087	R-8.3 c.i.	U-0.322	NR
Steel joist	U-0.038	R-30	U-0.038	R-30	U-0.069	R-13
Wood framed and other	U-0.033	R-30	U-0.033	R-30	U-0.066	R-13
Slab-on-grade floors						
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
Heated	F-0.900	R-10 for 24 in.	F-0.860	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.
Opaque doors						
Swinging	U-0.370		U-0.370		U-0.700	
Nonswinging	U-0.310		U-0.310		U-1.450	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.35	E&W-0.24, S-0.25, N-0.35	1.10	U-0.35	E&W-0.24, S-0.25, N-0.35	1.10	U-0.88	NR	NR
Metal framing, fixed	U-0.51			U-0.51			U-1.14		
Metal framing, operable	U-0.62			U-0.62			U-1.14		
Metal framing, entrance door	U-0.79			U-0.73			U-0.79		
Skylight, 0% to 3% of *roof*									
All types	U-0.62	0.33	NR	U-0.62	0.33	NR	U-1.71	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; FC = filled cavity (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.5).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

b. Exception applies for mass *walls* above grade where the requirement is for a maximum assembly U-0.151 (see ANSI/ASHRAE/IES Standard 90.1, Section 5.5.3.2).

TABLE E101.3 (TABLE E-3)
(SUPERSEDES TABLE 5.5-3 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 3 (A,B,C)* (I-P)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.039	R-25 c.i.	U-0.039	R-25 c.i.	U-0.119	R-7.6 c.i.
Metal building[a]	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.096	R-16
Attic and other roofs	U-0.027	R-38	U-0.027	R-38	U-0.053	R-19
Walls, above grade						
Mass	U-0.123	R-7.6 c.i.	U-0.104	R-9.5 c.i.	U-0.580	NR
Metal building	U-0.094	R-0 + R-9.8 c.i.	U-0.072	R-0 + R-13 c.i.	U-0.162	R-13
Steel framed	U-0.077	R-13 + R-5 c.i.	U-0.064	R-13 + R-7.5 c.i.	U-0.124	R-13
Wood framed and other	U-0.089	R-13	U-0.064	R-13 + R-3.8 c.i.	U-0.089	R-13
Wall, below grade						
Below-grade *wall*	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors						
Mass	U-0.074	R-10 c.i.	U-0.074	R-10 c.i.	U-0.137	R-4.2 c.i.
Steel joist	U-0.038	R-30	U-0.038	R-30	U-0.052	R-19
Wood framed and other	U-0.033	R-30	U-0.033	R-30	U-0.051	R-19
Slab-on-grade floors						
Unheated	F-0.730	NR	F-0.540	R-10 for 24 in.	F-0.730	NR
Heated	F-0.860	R-15 for 24 in.	F-0.860	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.
Opaque doors						
Swinging	U-0.370		U-0.370		U-0.370	
Nonswinging	U-0.310		U-0.310		U-0.360	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.31	E&W-0.24, S-0.25, N-0.35	1.10	U-0.33	E&W-0.24, S-0.25, N-0.35	1.10	U-0.83	NR	NR
Metal framing, fixed	U-0.43			U-0.47			U-1.14		
Metal framing, operable	U-0.57			U-0.57			U-1.14		
Metal framing, entrance door	U-0.73			U-0.65			U-0.73		
Skylight, 0% to 3% of *roof*									
All types	U-0.52	0.33	NR	U-0.52	0.33	NR	U-1.62	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; FC = filled cavity (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.5).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.4 (TABLE E-4)
(SUPERSEDES TABLE 5.5-4 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 4 (A,B,C)* (I-P)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.030	R-35 c.i.	U-0.030	R-35 c.i.	U-0.088	R-11 c.i.
Metal building [a]	U-0.035	R-11 + R-19 c.i.	U-0.035	R-11 + R-19 c.i.	U-0.078	R-19 + R-6.5 c.i.
Attic and other roofs	U-0.020	R-60	U-0.020	R-60	U-0.032	R-38
Walls, above grade						
Mass	U-0.099	R-11.4 c.i.	U-0.086	R-13.3 c.i.	U-0.580	NR
Metal building	U-0.057	R-11 + R-13 c.i.	U-0.048	R-11 + R-15.8 c.i.	U-0.154	R-19
Steel framed	U-0.061	R-13 + R-12.5 c.i.	U-0.061	R-13 + R-12.5 c.i.	U-0.118	R-13 + R-3.8 c.i.
Wood framed and other	U-0.061	R-13 + R-7.5 c.i.	U-0.061	R-13 + R-7.5 c.i.	U-0.085	R-13 + R-3.8 c.i.
Wall, below grade						
Below-grade *wall*	C-0.113	R-10.0 c.i.	C-0.087	R-12.5 c.i.	C-1.140	NR
Floors						
Mass	U-0.054	R-16.7 c.i.	U-0.048	R-18.7 c.i.	U-0.102	R-8.3 c.i.
Steel joist	U-0.036	R-38	U-0.036	R-38	U-0.049	R-30
Wood framed and other	U-0.031	R-38	U-0.031	R-38	U-0.048	R-30
Slab-on-grade floors						
Unheated	F-0.494	R-20 for 48 in.	F-0.494	R-20 for 48 in.	F-0.730	NR
Heated	F-0.801	R-20 for 48 in.	F-0.654	R-20 full slab	F-0.855	R-20 for 24 in.
Opaque doors						
Swinging	U-0.352		U-0.352		U-0.352	
Nonswinging	U-0.295		U-0.295		U-0.342	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.29	E&W-0.34, S-0.36, N-0.46	1.10	U-0.29	E&W-0.34, S-0.36, N-0.46	1.10	U-0.48	NR	NR
Metal framing, fixed	U-0.36			U-0.36			U-0.69		
Metal framing, operable	U-0.44			U-0.44			U-0.77		
Metal framing, entrance door	U-0.65			U-0.65			U-0.73		
Skylight, 0% to 3% of *roof*									
All types	U-0.48	0.38	NR	U-0.48	0.38	NR	U-1.09	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement.

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.5 (TABLE E-5)
(SUPERSEDES TABLE 5.5-5 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 5 (A,B,C)* (I-P)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.030	R-35 c.i.	U-0.030	R-35 c.i.	U-0.060	R-17 c.i.
Metal building [a]	U-0.035	R-11 + R-19 c.i.	U-0.035	R-11 + R-19 c.i.	U-0.078	R-19 + R-6.5 c.i.
Attic and other roofs	U-0.020	R-60	U-0.020	R-60	U-0.032	R-38
Walls, above grade						
Mass	U-0.086	R-13.3 c.i.	U-0.076	R-15.0 c.i.	U-0.143	R-7.5 c.i.
Metal building	U-0.048	R-11 + R-15.8 c.i.	U-0.048	R-11 + R-15.8 c.i.	U-0.089	R-11 + R-6.5 c.i.
Steel framed	U-0.052	R-13 + R-12.5 c.i.	U-0.052	R-13 + R-12.5 c.i.	U-0.080	R-13 + R-5.0 c.i.
Wood framed and other	U-0.048	R-13 + R-12.5 c.i.	U-0.048	R-13 + R-12.5 c.i.	U-0.085	R-13 + R-3.8 c.i.

Wall, below grade									
Below-grade *wall*	C-0.113	R-10.0 c.i.		C-0.087	R-12.5 c.i.		C-1.140	NR	
Floors									
Mass	U-0.054	R-16.7 c.i.		U-0.048	R-18.7 c.i.		U-0.102	R-8.3 c.i.	
Steel joist	U-0.036	R-38		U-0.036	R-38		U-0.049	R-30	
Wood framed and other	U-0.031	R-38		U-0.031	R-38		U-0.048	R-30	
Slab-on-grade floors									
Unheated	F-0.494	R-20 for 48 in.		F-0.485	R-20 for 48 in.		F-0.730	NR	
Heated	F-0.654	R-20 full slab		F-0.654	R-20 full slab		F-0.855	R-20 for 24 in.	
Opaque doors									
Swinging	U-0.352			U-0.352			U-0.352		
Nonswinging	U-0.295			U-0.295			U-0.342		
FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.29	E&W-0.36, S-0.38, N-0.48	1.10	U-0.29	E&W-0.36, S-0.38, N-0.48	1.10	U-0.43	NR	NR
Metal framing, fixed	U-0.36			U-0.36			U-0.59		
Metal framing, operable	U-0.44			U-0.44			U-0.67		
Metal framing, entrance door	U-0.65			U-0.65			U-0.73		
Skylight, 0% to 3% of *roof*									
All types	U-0.48	0.38	NR	U-0.48	0.38	NR	U-0.93	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement.

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.6 (TABLE E-6)
(SUPERSEDES TABLE 5.5-6 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 6 (A,B)* (I-P)

OPAQUE ELEMENTS	**NONRESIDENTIAL**		**RESIDENTIAL**		**SEMIHEATED**	
	ASSEMBLY MAXIMUM	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****
Roofs						
Insulation entirely above deck	U-0.030	R-35 c.i.	U-0.030	R-35 c.i.	U-0.060	R-17 c.i.
Metal building [a]	U-0.029	R-30 + R-11 Ls	U-0.028	R-10 + R-19 + R-13 c.i.	U-0.057	R-10 + R-10 + R-6.5 c.i.
Attic and other roofs	U-0.020	R-60	U-0.020	R-60	U-0.032	R-38
Walls, above grade						
Mass	U-0.076	R-15.0 c.i.	U-0.067	R-17.5 c.i.	U-0.143	R-7.5 c.i.
Metal building	U-0.048	R-11 + R-15.8 c.i.	U-0.048	R-11 + R-15.8 c.i.	U-0.089	R-11 + R-6.5 c.i.
Steel framed	U-0.047	R-13 + R-15.6 c.i.	U-0.047	R-13 + R-15.6 c.i.	U-0.080	R-13 + R-5 c.i.
Wood framed and other	U-0.048	R-13 + R-12.5 c.i.	U-0.048	R-13 + R-12.5 c.i.	U-0.085	R-13 + R-3.8 c.i.
Wall, below grade						
Below-grade *wall*	C-0.087	R-12.5 c.i.	C-0.060	R-17.5 c.i.	C-0.113	R-10.0 c.i.
Floors						
Mass	U-0.048	R-18.7 c.i.	U-0.048	R-18.7 c.i.	U-0.083	R-10 c.i.
Steel joist	U-0.030	R-49.0	U-0.030	R-49	U-0.049	R-30
Wood framed and other	U-0.026	R-38+ R-7.5 c.i.	U-0.026	R-38 + R-7.5 c.i.	U-0.048	R-30
Slab-on-grade floors						
Unheated	F-0.485	R-20 for 48 in.	F-0.412	R-15 full slab	F-0.730	NR
Heated	F-0.654	R-20 full slab	F-0.637	R-20 full slab	F-0.817	R-20 for 48 in.
Opaque doors						
Swinging	U-0.352		U-0.352		U-0.352	
Nonswinging	U-0.295		U-0.295		U-0.342	
FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.29	E&W-0.38, S-0.40, N-0.50	1.10	U-0.29	E&W-0.38, S-0.40, N-0.50	1.10	U-0.43	NR	NR
Metal framing,	U-0.34			U-0.34			U-0.48		

fixed									
Metal framing, operable	U-0.43			U-0.43			U-0.56		
Metal framing, entrance door	U-0.65			U-0.65			U-0.73		
Skylight, 0% to 3% of *roof*									
All types	U-0.48	0.38	NR	U-0.48	0.38	NR	U-0.81	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; *Ls* = *liner system* (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.4).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.7 (TABLE E-7)
(SUPERSEDES TABLE 5.5-7 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 7* (I-P)

OPAQUE ELEMENTS	NONRESIDENTIAL			RESIDENTIAL			SEMIHEATED		
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**		ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**		ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	
Roofs									
Insulation entirely above deck	U-0.027	R-40 c.i.		U-0.027	R-40 c.i.		U-0.037	R-26 c.i.	
Metal building [a]	U-0.028	R-10 + R-19 + R-13 c.i.		U-0.028	R-10 + R-19 + R-13 c.i.		U-0.035	R-11 + R-19 c.i.	
Attic and other roofs	U-0.016	R-71		U-0.016	R-71		U-0.026	R-49	
Walls, above grade									
Mass	U-0.067	R-17.5 c.i.		U-0.067	R-17.5 c.i.		U-0.117	R-9.5 c.i.	
Metal building	U-0.042	R-11 + R-19 c.i.		U-0.042	R-11 + R-19 c.i.		U-0.068	R-11 + R-9.8 c.i.	
Steel framed	U-0.047	R-13 + R-15.6 c.i.		U-0.040	R-13 + R-18.8 c.i.		U-0.061	R-13 + R-12.5 c.i.	
Wood framed and other	U-0.048	R-13 + R-12.5 c.i.		U-0.048	R-13 + R-12.5 c.i.		U-0.061	R-13 + R-7.5 c.i.	
Wall, below grade									
Below-grade *wall*	C-0.060	R-17.5 c.i.		C-0.060	R-17.5 c.i.		C-0.113	R-10.0 c.i.	
Floors									
Mass	U-0.040	R-23 c.i.		U-0.040	R-23 c.i.		U-0.070	R-12.5 c.i.	
Steel joist	U-0.030	R-49		U-0.030	R-49		U-0.049	R-30	
Wood framed and other	U-0.026	R-38 + R-7.5 c.i.		U-0.026	R-38 + R-7.5 c.i.		U-0.048	R-30	
Slab-on-grade floors									
Unheated	F-0.485	R-20 for 48 in.		F-0.412	R-15 full slab		F-0.730	NR	
Heated	F-0.637	R-20 full slab		F-0.637	R-20 full slab		F-0.817	R-20 for 48 in.	
Opaque doors									
Swinging	U-0.352			U-0.352			U-0.352		
Nonswinging	U-0.295			U-0.295			U-0.295		
FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.27	E&W-0.43, S-0.45, N-0.55	1.10	U-0.27	E&W-0.43, S-0.45, N-0.55	1.10	U-0.30	NR	NR
Metal framing, fixed	U-0.31			U-0.31			U-0.36		
Metal framing, operable	U-0.38			U-0.38			U-0.42		
Metal framing, entrance door	U-0.65			U-0.65			U-0.73		
Skylight, 0% to 3% of *roof*									
All types	U-0.48	NR	NR	U-0.48	NR	NR	U-0.81	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement.

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.8 (TABLE E-8)
(SUPERSEDES TABLE 5.5-8 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 8* (I-P)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation	U-0.027	R-40 c.i.	U-0.027	R-40 c.i.	U-0.037	R-26 c.i.

entirely above deck						
Metal building [a]	U-0.025	R-19 + R-19 + R-25 c.i.	U-0.025	R-19 + R-19 + R-25 c.i.	U-0.035	R-11 + R-19 c.i.
Attic and other roofs	U-0.016	R-71	U-0.016	R-71	U-0.026	R-49
Walls, above grade						
Mass	U-0.046	R-21.0 c.i.	U-0.046	R-21.0 c.i.	U-0.099	R-11.4 c.i.
Metal building	U-0.037	R-11 + R-22.1 c.i.	U-0.037	R-11 + R-22.1 c.i.	U-0.057	R-11 + R-13 c.i.
Steel framed	U-0.035	R-13 + R-21.9 c.i.	U-0.035	R-13 + R-21.9 c.i.	U-0.061	R-13 + R-12.5 c.i.
Wood framed and other	U-0.030	R-13 + R-21.9 c.i.	U-0.030	R-13 + R-21.9 c.i.	U-0.048	R-13 + R-12.5 c.i.
Wall, below grade						
Below-grade *wall*	C-0.060	R-17.5 c.i.	C-0.060	R-17.5 c.i.	C-0.113	R-10.0 c.i.
Floors						
Mass	U-0.036	R-25.1 c.i.	U-0.036	R-25.1 c.i.	U-0.061	R-14.6 c.i.
Steel joist	U-0.030	R-49	U-0.030	R-49	U-0.049	R-30
Wood framed and other	U-0.026	R-38 + R-7.5 c.i.	U-0.026	R-38 + R-7.5 c.i.	U-0.031	R-38
Slab-on-grade floors						
Unheated	F-0.412	R-15 full slab	F-0.403	R-15 full slab	F-0.513	R-20 for 24 in.
Heated	F-0.637	R-20 full slab	F-0.354	R-25 full slab	F-0.817	R-20 for 48 in.
Opaque doors						
Swinging	U-0.352		U-0.352		U-0.352	
Nonswinging	U-0.295		U-0.295		U-0.295	

FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.24	E&W-0.43, S-0.45, N-0.55	1.10	U-0.24	E&W-0.43, S-0.45, N-0.55	1.10	U-0.30	NR	NR
Metal framing, fixed	U-0.28			U-0.28			U-0.36		
Metal framing, operable	U-0.33			U-0.33			U-0.42		
Metal framing, entrance door	U-0.65			U-0.65			U-0.73		
Skylight, 0% to 3% of *roof*									
All types	U-0.39	NR	NR	U-0.39	NR	NR	U-0.81	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement.

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.0 (TABLE E-0)
(SUPERSEDES TABLE 5.5-0 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 0 (A,B)* (SI)

OPAQUE ELEMENTS	**NONRESIDENTIAL**		**RESIDENTIAL**		**SEMIHEATED**	
	ASSEMBLY MAXIMUM	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****
Roofs						
Insulation entirely above deck	U-0.222	R-4.4 c.i.	U-0.184	R-5.3 c.i.	U-1.240	R-0.7 c.i.
Metal building [a]	U-0.233	R-1.8 + R-3.3 FC	U-0.233	R-1.8 + R-3.3 FC	U-0.653	R-1.8
Attic and other roofs	U-0.153	R-6.7	U-0.153	R-6.7	U-0.459	R-2.3
Walls, above grade						
Mass [b]	U-3.293	NR	U-0.857	R-1.0 c.i.	U-3.293	NR
Metal building	U-0.533	R-0 + R-1.7 ci	U-0.533	R-0 + R-1.7 ci	U-1.998	NR
Steel framed	U-0.705	R-2.3	U-0.705	R-2.3	U-1.998	NR
Wood framed and other	U-0.504	R-2.3	U-0.504	R-2.3	U-1.660	NR
Wall, below grade						
Below-grade *wall*	C-6.473	NR	C-6.473	NR	C-6.473	NR
Floors						
Mass	U-1.825	NR	U-1.825	NR	U-1.825	NR
Steel joist	U-1.986	NR	U-1.986	NR	U-1.986	NR
Wood framed and other	U-1.599	NR	U-1.599	NR	U-1.599	NR
Slab-on-grade floors						
Unheated	F-1.264	NR	F-1.264	NR	F-1.264	NR
Heated	F-1.766	R-1.3 for 300 mm	F-1.766	R-1.3 for 300 mm	F-1.766	R-1.3 for 300 mm

Opaque doors									
Swinging	U-2.101			U-2.101			U-3.975		
Nonswinging	U-1.760			U-1.760			U-8.233		
FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX.U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing (all)	U-1.73	E&W-0.21, N&S-0.22	1.10	U-1.73	E&W-0.21, N&S-0.22	1.10	U-5.02	NR	NR
Metal framing, fixed	U-2.70			U-2.70			U-6.48		
Metal framing, operable	U-3.51			U-3.51			U-6.48		
Metal framing, entrance door	U-4.48			U-4.48			U-5.94		
Skylight, 0% to 3% of *roof*									
All types	U-4.05	0.33	NR	U-4.05	0.33	NR	U-9.71	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; FC = filled cavity (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.5).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

b. Exception applies for mass *walls* above grade where the requirement is for a maximum assembly U-0.151 (see ANSI/ASHRAE/IES Standard 90.1, Section 5.5.3.2).

TABLE E101.1 (TABLE E-1)
(SUPERSEDES TABLE 5.5-1 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 1 (A,B)* (SI)

OPAQUE ELEMENTS	**NONRESIDENTIAL**		**RESIDENTIAL**		**SEMIHEATED**	
	ASSEMBLY MAXIMUM	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****
Roofs						
Insulation entirely above deck	U-0.273	R-3.5 c.i.	U-0.220	R-4.4 c.i.	U-1.240	R-0.7 c.i.
Metal building [a]	U-0.233	R-1.8 + R-3.3 FC	U-0.233	R-1.8 + R-3.3 FC	U-0.653	R-1.8
Attic and other roofs	U-0.153	R-6.7	U-0.153	R-6.7	U-0.459	R-2.3
Walls, above grade						
Mass [b]	U-3.293	NR	U-0.857	R-1.0 c.i.	U-3.293	NR
Metal building	U-0.533	R-0 + R-1.7 c.i.	U-0.533	R-0 + R-1.7 c.i.	U-1.998	NR
Steel framed	U-0.705	R-2.3	U-0.705	R-2.3	U-1.998	NR
Wood framed and other	U-0.504	R-2.3	U-0.504	R-2.3	U-1.660	NR
Wall, below grade						
Below-grade *wall*	C-6.473	NR	C-6.473	NR	C-6.473	NR
Floors						
Mass	U-1.825	NR	U-1.825	NR	U-1.825	NR
Steel joist	U-1.986	NR	U-1.986	NR	U-1.986	NR
Wood framed and other	U-1.599	NR	U-1.599	NR	U-1.599	NR
Slab-on-grade floors						
Unheated	F-1.264	NR	F-1.264	NR	F-1.264	NR
Heated	F-1.766	R-1.3 for 300 mm	F-1.766	R-1.3 for 300 mm	F-1.766	R-1.3 for 300 mm
Opaque doors						
Swinging	U-2.101		U-2.101		U-3.975	
Nonswinging	U-1.760		U-1.760		U-8.233	
FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-2.70	E&W-0.24, S-0.25, N-0.35	1.10	U-2.70	E&W-0.24, S-0.25, N-0.35	1.10	U-5.02	NR	NR
Metal framing, fixed	U-3.08			U-3.08			U-6.48		
Metal framing, operable	U-3.51			U-3.51			U-6.48		
Metal framing, entrance door	U-5.94			U-5.94			U-5.94		
Skylight, 0% to 3% of *roof*									
All types	U-4.05	0.33	NR	U-4.05	0.33	NR	U-9.71	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; FC = filled cavity (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.5).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

b. Exception applies for mass *walls* above grade where the requirement is for a maximum assembly U-0.151 (see ANSI/ASHRAE/IES Standard 90.1, Section 5.5.3.2).

TABLE E101.2 (TABLE E-2)
(SUPERSEDES TABLE 5.5-2 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 2 (A,B)* (SI)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.220	R-4.4 c.i.	U-0.220	R-4.4 c.i.	U-0.982	R-0.9 c.i.
Metal building [a]	U-0.233	R-1.8 + R-3.3 FC	U-0.233	R-1.8 + R-3.3 FC	U-0.545	R-2.8
Attic and other roofs	U-0.153	R-6.7	U-0.153	R-6.7	U-0.300	R-3.3
Walls, above grade						
Mass [b]	U-0.857	R-1.0 c.i.	U-0.701	R-1.3 c.i.	U-3.293	NR
Metal building	U-0.533	R-0 + R-1.7 c.i.	U-0.533	R-0 + R-1.7 c.i.	U-0.920	R-2.3
Steel framed	U-0.479	R-2.3 + R-0.7 c.i.	U-0.365	R-2.3 + R-1.3 c.i.	U-0.705	R-2.3
Wood framed and other	U-0.504	R-2.3	U-0.504	R-2.3	U-0.504	R-2.3
Wall, below grade						
Below-grade *wall*	C-6.473	NR	C-6.473	NR	C-6.473	NR
Floors						
Mass	U-0.606	R-1.1	U-0.496	R-1.5	U-1.825	NR
Steel joist	U-0.214	R-5.3	U-0.214	R-5.3	U-0.390	R-2.3
Wood framed and other	U-0.188	R-5.3	U-0.188	R-5.3	U-0.376	R-2.3
Slab-on-grade floors						
Unheated	F-1.264	NR	F-1.264	NR	F-1.264	NR
Heated	F-1.558	R-1.8 for 600 mm	F-1.489	R-2.6 for 600 mm	F-1.766	R-1.3 for 300 mm
Opaque doors						
Swinging	U-2.101		U-2.101		U-3.975	
Nonswinging	U-1.760		U-1.760		U-8.233	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-2.00	E&W-0.24, S-0.25, N-0.35	1.10	U-2.00	E&W-0.24, S-0.25, N-0.35	1.10	U-5.02	NR	NR
Metal framing, fixed	U-2.91			U-2.91			U-6.48		
Metal framing, operable	U-3.51			U-3.51			U-6.48		
Metal framing, entrance door	U-4.48			U-4.15			U-4.48		
Skylight, 0% to 3% of *roof*									
All types	U-3.51	0.35	NR	U-3.51	0.33	NR	U-9.71	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; FC = filled cavity (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.5).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

b. Exception applies for mass *walls* above grade where the requirement is for a maximum assembly U-0.151 (see ANSI/ASHRAE/IES Standard 90.1, Section 5.5.3.2).

TABLE E101.3 (TABLE E-3)
(SUPERSEDES TABLE 5.5-3 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 3 (A,B,C)* (SI)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.220	R-4.4 c.i.	U-0.220	R-4.4 c.i.	U-0.677	R-1.3 c.i.
Metal building [a]	U-0.233	R-1.8 + R-3.3 FC	U-0.233	R-1.8 + R-3.3 FC	U-0.545	R-2.8
Attic and other	U-0.153	R-6.7	U-0.153	R-6.7	U-0.300	R-3.3

roofs						
Walls, above grade						
Mass	U-0.701	R-1.3 c.i.	U-0.592	R-1.7 c.i.	U-3.293	NR
Metal building	U-0.533	R-0 + R-1.7 c.i.	U-0.409	R-0 + R-2.3 c.i.	U-0.920	R-2.3
Steel framed	U-0.435	R-2.3 + R-0.9 c.i.	U-0.365	R-2.3 + R-1.3 c.i.	U-0.705	R-2.3
Wood framed and other	U-0.504	R-2.3	U-0.365	R-2.3 + R-0.7 c.i.	U-0.504	R-2.3
Wall, below grade						
Below-grade *wall*	C-6.473	NR	C-6.473	NR	C-6.473	NR
Floors						
Mass	U-0.420	R-1.8 c.i.	U-0.420	R-1.8 c.i.	U-0.780	R-0.7 c.i.
Steel joist	U-0.214	R-5.3	U-0.214	R-5.3	U-0.296	R-3.3
Wood framed and other	U-0.188	R-5.3	U-0.188	R-5.3	U-0.288	R-3.3
Slab-on-grade floors						
Unheated	F-1.264	NR	F-0.935	R-1.8 for 600 mm	F-1.264	NR
Heated	F-1.489	R-2.6 for 600 mm	F-1.489	R-2.6 for 600 mm	F-1.766	R-1.3 for 300 mm
Opaque doors						
Swinging	U-2.101		U-2.101		U-2.101	
Nonswinging	U-1.760		U-1.760		U-2.044	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-1.78	E&W-0.24, S-0.25, N-0.35	1.10	U-1.89	E&W-0.24, S-0.25, N-0.35	1.10	U-4.69	NR	NR
Metal framing, fixed	U-2.43			U-2.64			U-6.48		
Metal framing, operable	U-3.24			U-3.24			U-6.48		
Metal framing, entrance door	U-4.15			U-3.67			U-4.15		
Skylight, 0% to 3% of *roof*									
All types	U-2.97	0.33	NR	U-2.97	0.33	NR	U-9.17	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement; FC = filled cavity (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.5).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.4 (TABLE E-4)
(SUPERSEDES TABLE 5.5-4 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 4 (A,B,C)* (SI)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.173	R-6.2 c.i.	U-0.173	R-6.2 c.i.	U-0.502	R-1.9 c.i.
Metal building [a]	U-0.200	R-1.9 + R-3.3 c.i.	U-0.200	R-1.9 + R-3.3 c.i.	U-0.442	R-3.3 + R-1.1 c.i.
Attic and other roofs	U-0.113	R-10.6	U-0.113	R-10.6	U-0.183	R-6.7
Walls, above grade						
Mass	U-0.561	R-2.0 c.i.	U-0.486	R-2.3 c.i.	U-3.294	NR
Metal building	U-0.324	R-1.9 + R-2.3 c.i.	U-0.270	R-1.9 + R-2.8 c.i.	U-0.874	R-3.3
Steel framed	U-0.345	R-2.3 + R-2.2 c.i.	U-0.345	R-2.3 + R-2.2 c.i.	U-0.669	R-2.3 + R-0.7 c.i.
Wood framed and other	U-0.345	R-2.3 + R-1.3 c.i.	U-0.345	R-2.3 + R-1.3 c.i.	U-0.480	R-2.3 + R-0.7 c.i.
Wall, below grade						
Below-grade *wall*	C-0.642	R-1.8 c.i.	C-0.496	R-2.2 c.i.	C-6.475	NR
Floors						
Mass	U-0.308	R-2.9 c.i.	U-0.275	R-3.3 c.i.	U-0.577	R-1.5 c.i.
Steel joist	U-0.205	R-6.7	U-0.205	R-6.7	U-0.281	R-5.3
Wood framed and other	U-0.178	R-6.7	U-0.178	R-6.7	U-0.275	R-5.3
Slab-on-grade floors						
Unheated	F-0.855	R-3.5 for 1200 mm	F-0.855	R-3.5 for 1200 mm	F-1.264	NR
Heated	F-1.386	R-3.5 for 1200 mm	F-1.131	R-3.5 full slab	F-1.480	R-3.5 for 600 mm
Opaque doors						
Swinging	U-1.997		U-1.997		U-1.997	
Nonswinging	U-1.673		U-1.673		U-1.943	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-1.67	E&W-0.34, S-0.36, N-0.46	1.10	U-1.67	E&W-0.34, S-0.36, N-0.46	1.10	U-2.75	NR	NR
Metal framing, fixed	U-2.05			U-2.05			U-3.94		
Metal framing, operable	U-2.48			U-2.48			U-4.37		
Metal framing, entrance door	U-3.67			U-3.67			U-4.15		
Skylight, 0% to 3% of *roof*									
All types	U-2.70	0.38	NR	U-2.70	0.38	NR	U-6.21	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement.

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.5 (TABLE E-5)
(SUPERSEDES TABLE 5.5-5 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 5 (A, B, C)* (SI)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.173	R-6.2 c.i.	U-0.173	R-6.2 c.i.	U-0.340	R-3.0 c.i.
Metal building [a]	U-0.200	R-1.9 + R-3.3 c.i.	U-0.200	R-1.9 + R-3.3 c.i.	U-0.442	R-3.3 + R-1.1 c.i.
Attic and other roofs	U-0.113	R-10.6	U-0.113	R-10.6	U-0.183	R-6.7
Walls, above grade						
Mass	U-0.486	R-2.3 c.i.	U-0.432	R-2.6 c.i.	U-0.815	R-1.3 c.i.
Metal building	U-0.270	R-1.9 + R-2.8 c.i.	U-0.270	R-1.9 + R-2.8 c.i.	U-0.507	R-1.9 + R-1.1 c.i.
Steel framed	U-0.297	R-2.3 + R-2.2 c.i.	U-0.297	R-2.3 + R-2.2 c.i.	U-0.453	R-2.3 + R-0.9 c.i.
Wood framed and other	U-0.275	R-2.3 + R-2.2 c.i.	U-0.275	R-2.3 + R-2.2 c.i.	U-0.480	R-2.3 + R-0.7 c.i.
Wall, below grade						
Below-grade *wall*	C-0.642	R-1.8 c.i.	C-0.496	R-2.2 c.i.	C-6.475	NR
Floors						
Mass	U-0.308	R-2.9 c.i.	U-0.275	R-3.3 c.i.	U-0.577	R-1.5 c.i.
Steel joist	U-0.205	R-6.7	U-0.205	R-6.7	U-0.281	R-5.3
Wood framed and other	U-0.178	R-6.7	U-0.178	R-6.7	U-0.275	R-5.3
Slab-on-grade floors						
Unheated	F-0.855	R-3.5 for 1200 mm	F-0.839	R-3.5 for 1200 mm	F-1.264	NR
Heated	F-1.131	R-3.5 full slab	F-1.131	R-3.5 full slab	F-1.480	R-3.5 for 600 mm
Opaque doors						
Swinging	U-1.997		U-1.997		U-1.997	
Nonswinging	U-1.673		U-1.673		U-1.943	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-1.67	E&W-0.36, S-0.38, N-0.48	1.10	U-1.67	E&W-0.36, S-0.38, N-0.48	1.10	U-2.43	NR	NR
Metal framing, fixed	U-2.05			U-2.05			U-3.35		
Metal framing, operable	U-2.48			U-2.48			U-3.78		
Metal framing, entrance door	U-3.67			U-3.67			U-4.15		
Skylight, 0% to 3% of *roof*									
All types	U-2.70	0.38	NR	U-2.70	0.38	NR	U-5.29	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement.

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.6 (TABLE E-6)

(SUPERSEDES TABLE 5.5-6 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 6 (A,B)* (SI)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.173	R-6.2 c.i.	U-0.173	R-6.2 c.i.	U-0.340	R-3.0 c.i.
Metal building [a]	U-0.167	R-5.3 + R-1.9 Ls	U-0.156	R-1.8 + R-3.3 + R-2.3 c.i.	U-0.324	R-1.8 + R-1.8 + R-1.1 c.i.
Attic and other roofs	U-0.113	R-10.6	U-0.113	R-10.6	U-0.183	R-6.7
Walls, above grade						
Mass	U-0.432	R-2.6 c.i.	U-0.383	R-3.1 c.i.	U-0.815	R-1.3 c.i.
Metal building	U-0.270	R-1.9 + R-2.8 c.i.	U-0.270	R-1.9 + R-2.8 c.i.	U-0.507	R-1.9 + R-1.1 c.i.
Steel framed	U-0.264	R-2.3 + R-2.7 c.i.	U-0.264	R-2.3 + R-2.7 c.i.	U-0.453	R-2.3 + R-0.9 c.i.
Wood framed and other	U-0.275	R-2.3 + R-2.2 c.i.	U-0.275	R-2.3 + R-2.2 c.i.	U-0.480	R-2.3 + R-0.7 c.i.
Wall, below grade						
Below-grade *wall*	C-0.496	R-2.2 c.i.	C-0.340	R-3.1 c.i.	C-0.642	R-1.8 c.i.
Floors						
Mass	U-0.275	R-3.3 c.i.	U-0.275	R-3.3 c.i.	U-0.469	R-1.8 c.i.
Steel joist	U-0.173	R-8.6	U-0.173	R-8.6	U-0.281	R-5.3
Wood framed and other	U-0.146	R-6.7 + R-1.3 c.i.	U-0.146	R-6.7 + R-1.3 c.i.	U-0.275	R-5.3
Slab-on-grade floors						
Unheated	F-0.839	R-3.5 for 1200 mm	F-0.714	R-2.6 full slab	F-1.264	NR
Heated	F-1.131	R-3.5 full slab	F-1.103	R-3.5 full slab	F-1.414	R-3.5 for 1200 mm
Opaque doors						
Swinging	U-1.997		U-1.997		U-1.997	
Nonswinging	U-1.673		U-1.673		U-1.943	

FENESTRATION	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC	ASSEMBLY MAX. U	ASSEMBLY MAX. SHGC	ASSEMBLY MIN. VT/SHGC
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-1.62	E&W-0.38, S-0.40, N-0.50	1.10	U-1.62	E&W-0.38, S-0.40, N-0.50	1.10	U-2.43	NR	NR
Metal framing, fixed	U-1.94			U-1.94			U-2.75		
Metal framing, operable	U-2.43			U-2.43			U-3.18		
Metal framing, entrance door	U-3.67			U-3.67			U-4.15		
Skylight, 0% to 3% of *roof*									
All types	U-2.70	0.38	NR	U-2.70	0.38	NR	U-4.59	NR	NR

* The following definitions apply: c.i. = continuous insulation (ANSI/ASHRAE/IES Standard 90.1, see Section 3.2); NR = no (insulation) requirement; *Ls* = *liner system* (see ANSI/ASHRAE/IES Standard 90.1, Section A2.3.2.4).

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.7 (TABLE E-7)

(SUPERSEDES TABLE 5.5-7 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 7* (SI)

OPAQUE ELEMENTS	NONRESIDENTIAL		RESIDENTIAL		SEMIHEATED	
	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**	ASSEMBLY MAXIMUM	INSULATION MIN. R-VALUE**
Roofs						
Insulation entirely above deck	U-0.151	R-7.0 c.i.	U-0.151	R-7.0 c.i.	U-0.210	R-4.6 c.i.
Metal building [a]	U-0.156	R-1.8 + R-3.3 +R-2.3 c.i.	U-0.156	R-1.8 + R-3.3 + R-2.3 c.i.	U-0.200	R-1.9 + R-3.3 c.i.
Attic and other roofs	U-0.092	R-12.5	U-0.092	R-12.5	U-0.146	R-8.6
Walls, above grade						
Mass	U-0.383	R-3.1 c.i	U-0.383	R-3.1 c.i.	U-0.664	R-1.7 c.i.
Metal building	U-0.237	R-1.9 + R-3.3 c.i.	U-0.237	R-1.9 + R-3.3 c.i.	U-0.389	R-1.9 + R-1.7 c.i.
Steel framed	U-0.264	R-2.3 + R-2.7 c.i.	U-0.227	R-2.3 + R-3.3 c.i.	U-0.345	R-2.3 + R-2.2 c.i.
Wood framed and other	U-0.275	R-2.3 + R-2.2 c.i.	U-0.275	R-2.3 + R-2.2 c.i.	U-0.345	R-2.3 + R-1.3 c.i.

Wall, below grade									
Below-grade *wall*	C-0.340	R-3.1 c.i.		C-0.340	R-3.1 c.i.		C-0.642	R-1.8 c.i.	
Floors									
Mass	U-0.227	R-4.1 c.i.		U-0.227	R-4.1 c.i.		U-0.399	R-2.2 c.i.	
Steel joist	U-0.173	R-8.6		U-0.173	R-8.6		U-0.281	R-5.3	
Wood framed and other	U-0.146	R-6.7+ R-1.3 c.i.		U-0.146	R-6.7 + R-1.3 c.i.		U-0.275	R-5.3	
Slab-on-grade floors									
Unheated	F-0.839	R-3.5 for 1200 mm		F-0.714	R-2.6 full slab		F-1.264	NR	
Heated	F-1.103	R-3.5 full slab		F-1.103	R-3.5 full slab		F-1.414	R-3.5 for 1200 mm	
Opaque doors									
Swinging	U-1.997			U-1.997			U-1.997		
Nonswinging	U-1.673			U-1.673			U-1.673		
FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-1.51	E&W-0.43, S-0.45, N-0.55	1.10	U-1.51	E&W-0.43, S-0.45, N-0.55	1.10	U-1.73	NR	NR
Metal framing, fixed	U-1.78			U-1.78			U-2.05/		
Metal framing, operable	U-2.16			U-2.16			U-2.37		
Metal framing, entrance door	U-3.67			U-3.67			U-4.15		
Skylight, 0% to 3% of *roof*									
All types	U-2.70	NR	NR	U-2.70	NR	NR	U-4.59	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement.

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

TABLE E101.8 (TABLE E-8)
(SUPERSEDES TABLE 5.5-8 IN ANSI/ASHRAE/IES STANDARD 90.1) BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 8* (SI)

OPAQUE ELEMENTS	**NONRESIDENTIAL**		**RESIDENTIAL**		**SEMIHEATED**	
	ASSEMBLY MAXIMUM	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****	**ASSEMBLY MAXIMUM**	**INSULATION MIN. R-VALUE****
Roofs						
Insulation entirely above deck	U-0.151	R-7.0 c.i.	U-0.151	R-7.0 c.i.	U-0.210	R-4.6 c.i.
Metal building [a]	U-0.140	R-3.3 + R-3.3 + R-4.4 c.i.	U-0.140	R-3.3 + R-3.3 + R-4.4 c.i.	U-0.200	R-1.9 + R-3.3 c.i.
Attic and other roofs	U-0.092	R-12.5	U-0.092	R-12.5	U-0.146	R-8.6
Walls, above grade						
Mass	U-0.259	R-3.7 c.i.	U-0.259	R-3.7 c.i.	U-0.561	R-2.0 c.i.
Metal building	U-0.210	R-1.9 + R-3.9 c.i.	U-0.210	R-1.9 + R-3.9 c.i.	U-0.324	R-1.9 + R-2.3 c.i.
Steel framed	U-0.200	R-2.3 + R-3.9 c.i.	U-0.200	R-2.3 + R-3.9 c.i.	U-0.345	R-2.3 + R-2.2 c.i.
Wood framed and other	U-0.173	R-2.3 + R-3.9 c.i.	U-0.173	R-2.3 + R-3.9 c.i.	U-0.275	R-2.3 + R-2.2 c.i.
Wall, below grade						
Below-grade *wall*	C-0.340	R-3.1 c.i.	C-0.340	R-3.1 c.i.	C-0.642	R-1.8 c.i.
Floors						
Mass	U-0.205	R-4.4 c.i.	U-0.205	R-4.4 c.i.	U-0.345	R-2.6 c.i.
Steel joist	U-0.173	R-8.6	U-0.173	R-8.6	U-0.281	R-5.3
Wood framed and other	U-0.146	R-6.7 + R-1.3 c.i.	U-0.146	R-6.7 + R-1.3 c.i.	U-0.178	R-6.7
Slab-on-grade floors						
Unheated	F-0.714	R-2.6 full slab	F-0.697	R-2.6 full slab	F-0.888	R-3.5 for 600 mm
Heated	F-1.103	R-3.5 full slab	F-0.613	R-4.4 full slab	F-1.414	R-3.5 for 1200 mm
Opaque doors						
Swinging	U-1.997		U-1.997		U-1.997	
Nonswinging	U-1.673		U-1.673		U-1.673	
FENESTRATION	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**	**ASSEMBLY MAX. U**	**ASSEMBLY MAX. SHGC**	**ASSEMBLY MIN. VT/SHGC**
Vertical glazing, 0% to 40% of *wall*		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal	U-1.35	E&W-0.43,	1.10	U-1.35	E&W-0.43,	1.10	U-1.73	NR	NR

framing, all		S-0.45, N-0.55			S-0.45, N-0.55				
Metal framing, fixed	U-1.56			U-1.56			U-2.05		
Metal framing, operable	U-1.89			U-1.89			U-2.37		
Metal framing, entrance door	U-3.67			U-3.67			U-4.15		
Skylight, 0% to 3% of *roof*									
All types	U-2.21	NR	NR	U-2.21	NR	NR	U-4.59	NR	NR

* The following definitions apply: c.i. = continuous insulation (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2); NR = no (insulation) requirement.

** The insulation minimum R-value criteria in this table meet the criteria in Section 701.4.2.1 (7.4.2.1), but it is possible that some assemblies with slightly less insulation minimum R-value will also meet the criteria of Section 701.4.2.1 (7.4.2.1).

a. When using the R-value compliance method for metal building *roofs*, a thermal spacer block is required (see ANSI/ASHRAE/IES Standard 90.1, Section 3.2).

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INFORMATIVE APPENDIX F
INTEGRATED DESIGN

(This appendix is not part of this code. It is merely informative and does not contain requirements necessary for conformance to the code. It has not been processed according to the ANSI requirements for a code and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

SECTION F101 (F1)
Integrated Design Process/Integrated Project Delivery

Integrated design, and related concepts such as *integrated project delivery* and integrative design, leverages early stakeholder collaboration, through the sharing of knowledge and expertise among project team members, to develop stronger, more balanced design solutions. This *integrated design process* stands in contrast to traditional design methods, where there is

limited use of the skills and knowledge of all stakeholders. An *integrated design process* provides increased predictability of project outcomes earlier and enables the construction of *high-performance green buildings* that consume fewer resources and provide better comfort and functionality.

Integrated design introduces major issues and key participants into the project early, where more opportunities occur for creative problem solving. The complex interactions of sophisticated building systems require early coordination to maximize their effectiveness and output. Early team building and goal setting may also reduce total project costs. The collaborative process can inform *building envelope*, mechanical, electrical, plumbing, and other building system design. The later in the design process that systems are introduced, the more expensive their implementation will be. Information technology can also be a valuable asset in increasing predictability of outcomes earlier in the project and is recommended for all integrated teams.

In contrast with a linear design process, which addresses problems sequentially, an integrated process approaches each problem with input from the various viewpoints of the participants and the domains they represent, circling back after each design decision to collectively evaluate the impact on all stakeholders. This process acknowledges the complex interdependency of building systems and their relationship to resource consumption and occupant well being.

Several existing, and currently evolving, models for collaboration should be considered, including ASHRAE *Handbook—HVAC Applications*, Chapter 57; the MTS 1.0 WSIP Guide, *Whole Systems Integrated Process Guide for Sustainable Buildings and Communities*; and Integrated Project Delivery: A Guide by the AIA and AIA California Council.

Project-specific integrated design and/or *integrated project delivery* processes should be determined with full participation of the stakeholder team. What works for one project may not be the best approach for the next. Additionally, the team should collectively identify the performance standards and the associated metrics by which project success will be evaluated. Design charrettes of varying duration may be an effective tool to consider, though ultimately it is the responsibility of the stakeholder team to determine the process that will best fit a specific problem or project.

F101.1 (F1.1) Design Charrette.

The following outlines one type of design charrette process that resulted in a successful integrated design. A charrette process can be initiated at the initial stages of building design, and the members of the process should include all stakeholders.

Scheme #1—with Atrium, maximum exposure on the south, three-story office building.

BUILDING SYSTEM	HIGH-PERFORMANCE CRITERIA						
	SITE	IAQ	IEQ	ENERGY	COMM. M&V	INITIAL COST	O & M
Arch	8	7	6	1	6	1	6
HVAC	—	5	6	2	6	2	7
Plumbing	NA	—	—	—	—	2	7
Structural	—	—	—	—	—	2	
Aggregate index	8	6	6	1.5	6	2	6.8

Result:

Least numbers under energy and cost column defines consumption of substantial energy with high initial cost.

Scheme #2—without Atrium, three-story, minimum exposure on the south and west side.

BUILDING SYSTEM	HIGH-PERFORMANCE CRITERIA						
	SITE	IAQ	IEQ	ENERGY	COMM. M&V	INITIAL COST	O & M
Arch	6	7	7	7	7	7	6
HVAC	NA	5	7	7	7	7	7
Plumbing	NA	—	—	—	7	7	7
Structural	—	—	—	—	—		
Aggregate index	6	6	7	7	7	7	6.8

Result:

High numbers on all columns indicate the building is conceived optimally.

FIGURE F101.1 (FIGURE F-1)
SAMPLE CHARRETTE DESIGN MATRICES.

F101.1.1 (F1.1.1) Charrette Process.

Experienced personnel representing each specialty should participate in the charrette process. A discussion of all systems and all items that affect the *integrated design* should be discussed. Stakeholders should be able to decide and vote on the best integrated system.

The integrative team process should entail the following steps of design optimization:

a. The original goals and budget of the project should be revisited to see whether the overall intentions of the project are intact.
b. The project should be compared with this code or at least one existing green rating system.
c. Each of the building and *site* components should be scrutinized to help ensure that natural systems for energy conservation, lighting, ventilation, and passive heating and cooling are maximized before mechanical systems are engaged.
d. The appropriateness and integration logic of the building's primary systems should be confirmed.
e. The impact of the design on the *site* and its larger context should be evaluated, including the environmental impact on a life-cycle cost basis.
f. Building information modeling (BIM) software, design tools, and the experience of the design team should be used, where practical, to help optimize the design.
g. All members of the design team should be included when making design decisions.
h. Commissioning and consideration of future operation and maintenance (O&M) requirements should be included within the design optimization process.

F101.1.2 (F1.1.2) Design Charrette Matrix.

At the end of the charrette process, a matrix for each proposed building scheme can be developed and evaluated to summarize the impact on the *site*, water, energy, materials, and indoor environmental quality and to help in deciding on the best integrated system. The matrix contains cells indicating the high-performance value, grading a particular building system to its appropriate high-performance criteria. Each high-performance value is qualitatively rated from 1 to 10, with 1 being the lowest (minimal energy savings, low air quality, low water efficiency, high cost) and 10 being the highest (high energy savings, high air quality, high water efficiency, low cost). The average of the high-performance values for each building system is the aggregate index. Selection of the best system should be based on a comparison of the aggregate indices for each matrix.

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2018 2018 International Green Construction Code® (IgCC®)

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INFORMATIVE APPENDIX G INFORMATIVE REFERENCES

(This appendix is not part of this code. It is merely informative and does not contain requirements necessary for conformance to the code. It has not been processed according to the ANSI requirements for a code and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

This appendix contains informative references for the convenience of users of this code and to acknowledge source documents when appropriate. Section numbers indicate where the reference occurs in this document.

AIA

American Institute of Architects
1735 New York Avenue NW
Washington, DC 20006

AIA National/AIA California Council	Integrated Project Delivery: A Guide, v. 1-2007	Appendix F

AISC

American Institute of Steel Construction
130 East Randolph, Suite 2000
Chicago, Illinois 60601

Brochure	Steel Takes LEED® with Recycled Content	901.4.1.1 (9.4.1.1)

ASHRAE

1791 Tullie Circle NE
Atlanta, GA 30329

ASHRAE Guideline 0-2013	The Commissioning Process	1001.3.1.1 (10.3.1.1)
ASHRAE Guideline 1.1-2007	HVAC&R Technical Requirements for the Commissioning Process	1001.3.1.1 (10.3.1.1)
ASHRAE Guideline 4-2008 (RA 2013)	Preparation of Operating and Maintenance Documentation for Building Systems	1001.3.1.1 (10.3.1.1)
ASHRAE Handbook, 2017	Fundamentals	Appendix C
ASHRAE Handbook, 2015	HVAC Applications	Appendix F
ASHRAE Standard 62.1-2016 (Appendix C)	Ventilation for Acceptable Indoor Air Quality	Table 1001.3.1.4 (10.3.1.4)

APBP

Association of Pedestrian and Bicycle Professionals
201 East Main Street, Suite 1405
Lexington, KY 40507

Bicycle Parking Guidelines, 2nd Edition, 2010		501.3.7.2 (5.3.7.2)

ASTM

ASTM International
100 Barr Harbor Dr.
West Conshohocken, PA 19428-2959

ASTM C755-10 (2015)	Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation, Appendix X1 Problem Analysis	801.3.6 (8.3.6)
ASTM E1331-15	Standard Test Method for Reflectance Factor and Color by Spectrophotometry Using Hemispherical Geometry	801.4.1 (8.4.1)
ASTM E1477 - 98a (2013)	Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of IntegratingSphere Reflectometers	801.4.1 (8.4.1)
ASTM E2813-12e1	Standard Practice for Building Enclosure Commissioning	1001.3.1.3.5 (10.3.1.3.5)

BSI

British Standards Institute
389 Chiswick High Road
London, W4 4AL,United Kingdom

BS 8493:2008+A1:2010	Light reflectance value (LRV) of a surface. Method of test.	801.4.1 (8.4.1)

calEPA

California Environmental Protection Agency
Office of Environmental Health Hazard Assessment
Post Office Box 4010
Sacramento, CA 95812-4010

http://www.oehha.org/air/allrels.html	All OEHHA Acute, 8-hour and Chronic Reference Exposure Levels (chRELs) as of June 2014	801.4.2 (8.4.2), 801.5.2 (8.5.2)

CBE

Center for the Built Environment
University of California, 390 Wurster Hall #1839
Berkeley, CA 94720-1839

http://www.cbe.berkeley.edu/research/survey.htm	Indoor Environmental Quality (IEQ) Survey™	1001.3.2.1.5 (10.3.2.1.5)

CRI

Carpet and Rug Institute
100 South Hamilton Street
Dalton, Georgia 30720

801.4.2.3 (8.4.2.3)

CSA

Canadian Standards Association
5060 Spectrum Way, Suite 100
Mississauga, Ontario, L4W 5N6,Canada

CSA S478-95 (R2007)	Guideline on Durability for Buildings	901.4.1 (9.4.1), 1001.3.2.3 (10.3.2.3)

DGS

State of California, Department of General Services, Procurement Division
Ziggurat Building
707 Third Street
West Sacramento, CA 95605-2811

RFP DGS-56275	Section 5.7, “Indoor Air Quality Requirements for Open Office Panel Systems”	Appendix D

DHHS ATSDR

United States Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
4770 Buford Hwy NE
Atlanta, GA 30341

www.atsdr.cdc.gov/mrls	Minimal Risk Levels (MRLs)	Table 1001.3.1.5 (10.3.1.5)

EPA

United States Environmental Protection Agency
1200 Pennsylvania Ave NW
Washington, DC 20460

Portfolio Manager	1001.3.2.1.3.2 (10.3.2.1.3.2)

FSC

Forest Stewardship Council
1155 30th Street NW, Suite 300
Washington, DC 20007

901.4.1.3.1 (9.4.1.3.1)

GSA

United States General Services Administration
1800 F Street, NW
Washington, DC 20405

U.S. GSA-2005	The Building Commissioning Guide	1001.3.1 (10.3.1)

ICC

International Code Council
500 New Jersey Ave NW # 300
Washington, DC 20001

IBC-2018	International Building Code®	106.1, 801.3.1.8 (8.3.1.8), I201.1 (I2.1)
IECC-2018	International Energy Conservation Code®	Appendix H
IFC-2018	International Fire Code®	601.3.2.6 (6.3.2.6)
IPC-2018	International Plumbing Code®	601.3.1.2.1 (6.3.1.2.1)
ICC/ASHRAE 700–2015	National Green Building Standard	J101.1.1, J101.1.2, J101.1.3, J101.1.4, J101.1.5

IES

Illuminating Engineering Society
120 Wall Street, Floor 17
New York, NY 10005-4001

IDA/IES Model Lighting Ordinance	Model Lighting Ordinance (MLO)	501.3.6 (5.3.6)

ITE

Institute of Transportation Engineers
1627 Eye Street, NW, Suite 600
Washington, DC 20006

4th Edition, 2004	Parking Generation	1001.3.2.4 (10.3.2.4)

MTS

The Institute for Market
Transformation to Sustainability
1511 Wisconsin Avenue, N.W.
Washington, D.C. 20007

MTS 1.0 WSIP Guide-2007	Whole Systems Integrated Process Guide for Sustainable Buildings and Communities	Appendix F

NIBS

National Institute of Building Sciences
1090 Vermont Avenue, NW, Suite 700
Washington, DC 20005-4905

NIBS Guideline 3-2012	Building Enclosure Commissioning Process BECx	1001.3.1.3.5 (10.3.1.3.5)

NREL

National Renewable Energy
Laboratory
1617 Cole Blvd.
Golden, CO 80401-3393

NREL/TP-550-38617	Source Energy and Emissions Factors for Energy Use in Buildings	Table 701.5.2B (7.5.2B)

RFCI

Resilient Floor Covering Institute
115 Broad Street, Suite 201
LaGrange, GA 30240

801.4.2.3 (8.4.2.3)

SFI

Sustainable Forestry Initiative, Inc.
1600 Wilson Blvd, Suite 810
Arlington, VA 22209

901.4.1.3.1 (9.4.1.3.1)

SMACNA

Sheet Metal and Air Conditioning
Contractors National Association
4201 Lafayette Center Drive
Chantilly, VA 20151

ANSI/SMACNA 008-2008	IAQ Guidelines for Occupied Buildings under Construction, Second Edition	1001.3.1.5 (10.3.1.5)

SRI

Steel Recycling Institute
680 Andersen Drive
Pittsburgh, PA 15220

Brochure	Steel Takes LEED® With Recycled Content	901.4.1.1 (9.4.1.1)

UBT

Usable Buildings Trust

Occupant Satisfaction Evaluation Survey	http://www.busmethodology.org.uk; info@busmethodology.org.uk	1001.3.2.1.5 (10.3.2.1.5)

UL	UL Environment 2211 Newmarket Parkway, #110 Marietta, GA 30067	
UL2818-2013	Greenguard Certification Program for Chemical Emissions for Building Materials, Finishes and Furnishing	801.4.2 (8.4.2), 801.5.2 (8.5.2)
UL2821-2013	Greenguard Certification Program Method for Measuring and Evaluating Chemical Emissions from Building Materials, Finishes and Furnishings	801.4.2 (8.4.2), 801.5.2 (8.5.2)

Sitemap

Global Services

General Code

Flickr

Legal

Member Career Center

Alliance for National & Community Resilience

Peridicals and Newsroom

Learning Center

Government Relations

Scholarships

Privacy Policy

Consumer Saftey

Code of Ethics

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INFORMATIVE APPENDIX H
OPTION FOR ENERGY EFFICIENCY USING THE IECC PRESCRIPTIVE COMPLIANCE PATH

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

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The purpose of this appendix is to provide users of the prescriptive energy path of the IECC a correlated version of ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1, Chapter 7 (Section 7), that facilitates the use of the prescriptive provisions of

the IECC without directly relying on the energy provisions of ANSI/ASHRAE/IES Standard 90.1. Section numbers in this appendix, unless otherwise specified, refer to Standard 189.1. Where ASHRAE standards are referenced in this appendix, ASHRAE provides free online access to readonly versions of the standards. See https://www.ashrae.org/standards-research-technology/standards--guidelines/other-ashrae-standards-referenced-in-code.

SECTION H101 (H1.)
DEFINITIONS APPLICABLE TO THIS APPENDIX

air, outdoor: see ANSI/ASHRAE Standard 62.1.

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

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

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

fenestration: see ANSI/ASHRAE/IES Standard 90.1.

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

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

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

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

roof: see ANSI/ASHRAE/IES Standard 90.1.

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

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

skylight: see ANSI/ASHRAE/IES Standard 90.1.

space: see ANSI/ASHRAE/IES Standard 90.1.

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

SECTION H201 (H2.)
GENERAL

H201.1 (H2.1) Scope.

This section specifies prescriptive requirements for energy efficiency for buildings and appliances, for *on-site renewable energy systems*, and for energy measuring.

SECTION H301 (H3.)
COMPLIANCE

H301.1 (H3.1) Compliance.

The energy systems shall comply with Sections 701.3.2 (7.3.2) through 701.3.4 (7.3.4) and with the *International Energy Conservation Code* (IECC), Sections C402 through C405. In addition, commercial buildings shall comply with the IECC, Section C406, and tenant *spaces* shall comply with the IECC, Section C406.1.1.

Where requirements are provided below, they shall supersede the requirements of the IECC. For all other criteria, the *building project* shall comply with the requirements of the IECC.

SECTION H401 (H4.)
PRESCRIPTIVE REQUIREMENTS

H401.1 (H4.1) On-Site Renewable Energy Systems.

Building projects shall comply with either the standard renewables approach in Section 701.4.1.1.1 (7.4.1.1.1) or the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2).

H401.2 (H4.2) Building Envelope.

The *building envelope* shall comply with the IECC, Sections C301 and C402, with the following modifications and additions.

H401.2.1 (H4.2.1) Continuous Air Barrier.

The exceptions to the requirement for a *continuous air barrier* in the IECC, Section C402.5.1, for specific *climate zones* and constructions shall not apply.

H401.2.2 (H4.2.2) Building Envelope Requirements.

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 *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*.

H401.2.3 (H4.2.3) *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.

H401.2.4 (H4.2.4) Air Curtains.

Where provided, air curtains shall comply with Section 701.4.2.4 (7.4.2.4).

H401.2.5 (H4.2.5) High-Speed Doors.

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

H401.2.6 (H4.2.6) Vertical Fenestration Area.

Vertical fenestration area shall comply with the IECC, Sections C402.4.1 and C402.4.1.1.

H401.2.7 (H4.2.7) Permanent Projections.

Vertical fenestration shall comply with Section 701.4.2.6 (7.4.2.6).

H401.2.8 (H4.2.8) SHGC of Vertical Fenestration.

Vertical fenestration shall comply with the IECC, Table C402.4.

H401.2.9 (H4.2.9) Building Envelope Trade-Off Option.

The *building envelope* component performance alternative of the IECC, Section C402.1.5, shall not apply except where the modifications and additions of Section H401.2 (H4.2) are incorporated.

H401.2.10 (H4.2.10) Orientation.

The *vertical fenestration* shall comply with either (a) or (b):

a. $A_W \le (A_N + A_S)/4$ and $A_E \le (A_N + A_S)/4$
b. $A_W \times SHGC_W \le (A_N \times SHGC_C + A_S \times SHGC_C)/6$ and $A_E \times SHGC_E \le (A_N \times SHGC_C + A_S \times SHGC_C)/6$

where:

$SHGC_X$ = the *SHGC* for orientation x that complies with Section H401.2.7 (H4.2.7).
$SHGC_C$ = the *SHGC* criteria for each *climate zone* from Section H401.2.2 (H4.2.2).
A_X = *fenestration area* for orientation x.
N = north (oriented less than 45 degrees of true north).
S = south (oriented less than 45 degrees of true south).
E = east (oriented less than or equal to 45 degrees of true east).
W = west (oriented less than or equal to 45 degrees of true west).

Exceptions:

1. Buildings with shade on 75% of the west- and east-oriented *vertical fenestration areas* from permanent projections, existing buildings, existing permanent infrastructure, or topography at 9 a.m. and 3 p.m. on the summer solstice (June 21 in the northern hemisphere).
2. Alterations and additions with no increase in *vertical fenestration area*.
3. Buildings where the west- and east-oriented *vertical fenestration areas* do not exceed 20% of the *gross wall area* for each of those façades, and the *SHGC* on those façades is not greater than 90% of the criteria in Section H401.2.2 (H4.2.2).
4. Buildings in *Climate Zone* 8.

H401.3 (H4.3) Heating, Ventilating, and Air Conditioning.

The heating, ventilating, and air conditioning shall comply with the IECC, Sections C301 and C403, with the following modifications and additions.

H401.3.1 (H4.3.1) Minimum Equipment Efficiencies for the Alternate Renewables Approach.

Building projects complying with the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2) shall comply with Section 701.4.3.1 (7.4.3.1).

H401.3.2 (H4.3.2) Ventilation Controls for Densely Occupied Spaces.

The requirements in this section supersede those in the 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)

The *DCV* system shall be designed to be in compliance with ANSI/ASHRAE Standard 62.1, Section 6.2.7. Occupancy assumptions shall be shown in the design documents for *spaces* provided with *DCV*. All CO_2 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 CO_2 sensors or air-sampling probes leading to a central CO_2 monitoring station shall be provided with at least one sensor or probe for each 10,000 ft^2 (1000 m^2) of floor *space*. Sensors or probes shall be installed between 3 and 6 ft (1 and 2 m) above the floor.

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

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

1. *Outdoor air* CO_2 concentrations shall be dynamically measured using one or multiple CO_2 sensors. The CO_2 sensor locations shall be identified on the *construction documents*.
2. When documented statistical data are available on the local ambient CO_2 concentrations, a fixed value typical of the location where the building is located shall be allowed in lieu of an outdoor sensor.

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

Exceptions:

1. Systems with exhaust air energy recovery complying with Section H401.3.6 (H4.3.6).
2. Systems with a design outdoor airflow less than 750 cfm (350 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 *spaces*.
4. *Spaces* with one of the following occupancy categories as defined in ASHRAE Standard 62.1: cells in correctional facilities; daycare sickrooms; science laboratories; barbershops; beauty and nail salons; and bowling alleys (seating).

H401.3.3 (H4.3.3) Duct Leakage Tests.

Leakage tests shall be performed in compliance 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.

H401.3.4 (H4.3.4) Economizers.

Where economizers are required by Section 701.4.3.4 (7.4.3.4), economizers shall meet 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 the IECC, Section C403.8.

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. Where the reduced renewable approach defined in Section 701.4.1.1.2 (7.4.1.1.2) is used, the 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). If the standard renewable approach is chosen, as defined in Section 701.4.1.1.2 (7.4.1.1.2), then the requirements in the IECC, Table C403.5(2), shall be applied to the efficiency requirements in the IECC, Tables C403.3.2(1) through C403.3.2(10).

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

H401.3.5 (H4.3.5) Fan System Power and Efficiency

H401.3.5.1 (H4.3.5.1) 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.

H401.3.5.2 (H4.3.5.2) 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.

H401.3.6 (H4.3.6) 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.

H401.3.7 (H4.3.7) Kitchen Exhaust Systems.

The requirements in the IECC, Section C403.7.5, shall apply, except as modified by Sections 701.4.3.8.1 (7.4.3.8.1) and 701.4.3.8.2 (7.4.3.8.2).

H401.3.8 (H4.3.8) Duct Insulation.

Duct insulation shall comply with the minimum requirements in Normative Appendix A, Tables A101.2 (A-2) and A101.3 (A-3). These requirements supersede the requirements in the IECC, Section C403.11.1.

H401.3.9 (H4.3.9) Automatic Control of HVAC and Lights in Hotel/Motel Guest Rooms.

Controls in hotel and motel guest rooms shall comply with Section 701.4.3.10 (7.4.3.10).

H401.3.10 (H4.3.10) HVAC Equipment Performance Requirements.

Equipment shall meet the minimum efficiency requirements of ANSI/ASHRAE/IES Standard 90.1, Section 6.4.1, or of the IECC, Section C403.3.2.

Note: Some 2018 IECC minimum efficiency requirements are below Federal minimum standards. Users may want to verify applicable requirements.

H401.4 (H4.4) Service Water Heating.

The *service water heating* shall comply with the IECC, Section C404, with the following modifications and additions.

H401.4.1 (H4.4.1) Equipment Efficiency for the Alternate Renewables Approach.

Building projects complying with the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2) shall comply with the applicable equipment efficiency requirements in Normative Appendix B, Table B101.9 (B-9), and the applicable ENERGY STAR® requirements in Section 701.4.7.3 (7.4.7.3). These requirements supersede the requirements in the IECC, Table C404.2.

H401.4.2 (H4.4.2) Insulation for Spa Pools.

Insulation for spa pools shall comply with Section 701.4.4.2 (7.4.4.2).

H401.5 (H4.5) Lighting.

The lighting shall comply with the IECC, Sections C405.2 through C405.4, with the following modifications and additions.

H401.5.1 (H4.5.1) Lighting Power Allowance

H401.5.1.1 (H4.5.1.1) Interior Lighting Power Densities (LPDs).

The interior *lighting power allowance* shall comply with Section 701.4.6.1.1 (7.4.6.1.1).

H401.5.1.2 (H4.5.1.2) 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 applicable LPD Factor from Table 701.4.6.1.2 (7.4.6.1.2).

H401.5.2 (H4.5.2) Occupancy Sensor Controls with Multilevel Switching or Dimming.

Lighting in commercial and industrial storage stack areas shall comply with Section 701.4.6.2 (7.4.6.2).

H401.5.3 (H4.5.3) Automatic Controls for Egress and Security Lighting.

Automatic controls for egress and security lighting shall comply with Section 701.4.6.3 (7.4.6.3).

H401.5.4 (H4.5.4) Controls for Exterior Sign Lighting.

Controls for exterior sign lighting shall comply with Section 701.4.6.4 (7.4.6.4).

H401.5.5 (H4.5.5) Parking and Outdoor Sales Lighting.

This section supersedes the IECC, Section C.405.4.2, for lighting serving uncovered parking areas. 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 controlled zone for a period no longer than 15 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.

H401.5.6 (H4.5.6) Other Equipment.

The other equipment shall comply with the IECC, Sections C405.5 through C405.9, with the following additions.

H401.5.6.1 (H4.5.6.1) Equipment Efficiency for the Alternate Renewables Approach.

Building projects complying with the Alternate Renewables Approach in Section 701.4.1.1.2 (7.4.1.1.2) 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).

H401.5.6.2 (H4.5.6.2) Supermarket Heat Recovery.

Supermarkets shall comply with Section 701.4.7.2 (7.4.7.2), as applicable.

H401.5.6.3 (H4.5.6.3) ENERGY STAR Equipment.

All *building projects* shall comply with Section 701.4.7.3 (7.4.7.3).

H401.5.6.4 (H4.5.6.4) Programmable Thermostats.

Residential programmable thermostats shall comply with Section 701.4.7.4 (7.4.7.4).

H401.5.6.5 (H4.5.6.5) Refrigerated Display Cases.

Refrigerated display cases shall comply with Section 701.4.7.5 (7.4.7.5).

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20_INFORMATIVE APPENDIX I ADDITIONAL GUIDANCE FOR FUNCTIONAL AND PERFORMANCE TESTING (FPT) AND THE COMMISSIONING (CX) PROCESS | 2018 2018 International Green Construction Code® (IgCC®) | ICC premiumACCESS

SourceURL: https://codes.iccsafe.org/content/IGCC2018/informative-appendix-i-additional-guidance-for-functional-and-performance-testing-fpt-and-the-commissioning-cx-process

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INFORMATIVE APPENDIX I
ADDITIONAL GUIDANCE FOR FUNCTIONAL AND PERFORMANCE TESTING (FPT) AND THE COMMISSIONING (CX) PROCESS

(This appendix is not part of this code. It is merely informative and does not contain requirements necessary for conformance to the code. It has not been processed according to the ANSI requirements for a code and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

This appendix provides guidance on best practices for *functional and performance testing (FPT)* and the *commissioning (Cx) process* that relate to Section 1001.3.1.1 (10.3.1.1).

SECTION I101 (I1.)
PROVIDER QUALIFICATIONS

I101.1 (I1.1) Recommended Minimum Qualifications and Independence of a Commissioning (Cx) Provider and a Functional and Performance Testing (FPT) Provider.

A *commissioning (Cx) provider* or an *FPT provider* should have the following qualities to ensure the needed qualifications and independence for *building project* testing or commissioning:

a. **Equipment.** A *Cx provider* or *FPT provider* should use equipment necessary to carry out the *commissioning (Cx) process* and *FPT*. Equipment should be calibrated in accordance with the manufacturer's specifications.

b. **Personnel Experience.** The *Cx provider* or *FPT provider* should provide personnel experienced in conducting, supervising, or evaluating *functional and performance testing*, inspections, and, where applicable, performing commissioning activities prior to and subsequent to the tests. Where possible, the *Cx provider* should have completed the *Cx process* on not fewer than two projects of equal or greater scope and complexity, or should be able to demonstrate adequate experience and training in the fundamentals and application of the *Cx process*.

c. **Independence.** The *Cx provider* and the *FPT provider* should be independent of the building system design and construction functions of the systems being commissioned. The *Cx provider* and *FPT provider* should disclose possible conflicts of interest to ensure objectivity.

d. **Registration, Licensure, or Certification of a Cx Provider.** Where available, a *Cx provider* should be registered or licensed in a relevant discipline or certified according to the provisions of ISO 17024 or an equivalent certification process.

I101.2 (I1.2) Overview of the Cx Process.

Table I101.2 (I1.2) provides an overview of activities, documentation, and responsibilities that should be included in the *Cx process*.

TABLE I101.2 (TABLE I1.2)
TYPICAL CX PROCESS ACTIVITIES, DELIVERABLES, AND RESPONSIBILITIES

ITEM	ACTIVITY	DELIVERABLE	NORMALLY PROVIDED BY
1	*Owner's project requirements*	*OPR* document	*Owner* with assistance from design and Cx teams
2	*Basis of Design*	*BoD* document	Design team
3	*Cx plan*	*Cx plan* document	*Cx provider* with input from *owner*, design team, and contractor
4	Contractor Cx requirements	Cx specifications	Design team and *Cx provider*
5	Design review	Cx design review report	*Cx provider*
6	Submittal review	Submittal review report	*Cx provider*
7	Commissioning designated systems inspections, *functional and performance testing*	Installation, inspection, functional test reports, performance test reports	Contractors, manufacturers, *Cx provider* and team
8	Issue and resolution log	Issue and resolution logs	*Cx provider* and team
9	Systems manual	Systems manual	Contractors with review by *Cx provider*
10	Training	Training plan and reports	Contactor and manufacturers with review by *Cx provider*
11	Preliminary Cx report	Preliminary Cx report	*Cx provider*
12	Cx activities during occupancy	Additional information and updates to reports	*Cx provider* and building operations
13	Final Cx report	Final Cx report	*Cx provider*

SECTION I201 (I2.)
CX DOCUMENTATION

The *Cx process* should result in the following deliverables.

I201.1 (I2.1) Typical Elements Included in Owner's Project Requirements (OPR).

The *OPR* is a document developed by the *owner* with assistance from the design and Cx teams that details the requirements of a project and the expectations for how it will be used and operated. The *OPR* should include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. The term "project intent" or "design intent" is used by some *owners* for their *Cx process OPR*.

The *OPR* document should address the following for the commissioned systems:

a. Facility objectives, size, location, user requirements, and *owner* directives, including *space* use and occupancy/operations schedules and special project requirements.

b. Applicable codes and standards, in addition to local building codes (**Informative note:** e.g., *International Building Code*), and environmental, sustainability, and efficiency goals and benchmarks.

c. Indoor environment requirements, including temperature, humidity, and ventilation.

d. *Cx process* scope and requirements; listing of equipment; systems and assemblies requiring commissioning, including installation, evaluation, and testing requirements; and *commissioning (Cx) plan* and report formats and distribution requirements. Sampling procedures, if permitted, for all reviews, evaluations, and testing should be detailed.

e. Equipment, systems, and assemblies requirements, expectations, and warranty provisions.

f. Maintainability, access, and operational performance requirements.

g. Project documentation requirements, including formats and delivery schedules for *Basis of Design (BoD)*, Cx specifications, *Cx plan* and reports, equipment submittals, and the systems manual; documentation reviews, approvals, and distribution during design and construction phases.

h. Training requirements for *owner*'s operation and maintenance personnel and occupants.

I201.2 (I2.2) Basis of Design (BoD).

The *BoD* is a document developed by the design team that records the concepts, calculations, decisions, and product selections used to meet the *OPR* and to satisfy applicable regulatory requirements, standards, and guidelines. The document should include both narrative descriptions and lists of individual items that support the design process, including the following:

a. A detailed description of the design team's technical approach to, and assumptions about, the *OPR*.

b. A platform for the review of the design and for changes as the project progresses.

c. A detailed description addressing coordination of applicable technical and code requirements.

I201.3 (I2.3) Cx Plan.

A *Cx plan* is a document developed by a *Cx provider* that should include the following:

a. An overview of the *Cx process* developed specifically for the project.
b. The roles and responsibilities of the *Cx provider* and the Cx team through final commissioning activities.
c. Documentation of communication channels and processes, including distribution of the *Cx plan*, logs, testing documents, and reports during the design and construction processes.
d. A detailed description and schedule of *Cx process* activities and the list of operations, systems, and assemblies that will be commissioned, and a description of performance criteria where not shown on the *construction documents*.
e. The project design documentation and submittal review procedures and reports.
f. Inspection checklists and testing forms, issues and resolution log, and Cx progress reports to be used during the project to communicate and track commissioning and inspection process information, including format, approvals, and distribution.
g. The procedures to follow for resolution where the Cx evaluation does not meet the *OPR*.

I201.4 (I2.4) Cx Specifications.

For construction or renovation projects requiring contract documents, the *owner* should require by agreement that the design/construction team include Cx specifications in the project contract documents. The Cx specification should require compliance with the *OPR* and with the *Cx process* contained in the project's *Cx plan* as detailed in this code.

I201.5 (I2.5) Cx Design Review Report.

The *Cx provider* should provide a design review (Cx Design Review Report) to the *owner* and design teams to report compliance with the *OPR* and *BoD*. This Cx design review is not intended to replace a design peer review or a code or regulatory review.

I201.6 (I2.6) Record Documents.

Record documents should be provided to the *owner* upon project completion. The record documents should be accessible to the building operations and maintenance personnel, be included in the systems manual, and include all of the following:

a. Approved *construction documents*, including record plans and specifications.
b. Approved submittals and coordination drawings. This documentation should show the actual locations of equipment, systems, and assemblies, such as piping, ductwork, valves, controls, access panels, electrical equipment, plumbing equipment, lighting and other operating components and systems. The record documents should particularly note equipment locations that are concealed or are installed in locations other than those indicated on the approved *construction documents*.
c. Engineering and institutional control information for sites that have previously been a *brownfield* or that have required environmental corrective action, remediation, or restoration at the federal, state, or local level.

I201.7 (I2.7) Systems Manual.

A systems manual should be provided by an *owner* for use in building operations training. The systems manual should be made accessible to building operations and maintenance (O&M) personnel and should be updated and maintained by an *owner* for the life of the building.

A systems manual should include the following:

a. Facility design and *construction documents*, including the following:
    1. *OPR* and *BoD*.
    2. Construction record documents, including drawings, specifications, and approved submittals.
b. Facility systems and assemblies information, including the following:
    1. Manufacturer's O&M data for installed equipment systems and assemblies.
    2. Warranties and certificate of occupancy.
    3. Contractor and supplier listing and contact information.
c. A facility operations guide, including an operating plan, building and equipment operating schedules, set points and ranges, verified sequences of operation, system and equipment limitations, and emergency procedures.
d. Where training is provided, training plans, materials, and records.
e. A final commissioning report.

I201.8 (I2.8) Preliminary Cx Report.

A preliminary Cx report should be provided by the *Cx provider* and should include the following information:

a. Performance of commissioned equipment, systems, and assemblies.
b. Issue and resolution logs, including itemization of deficiencies found during testing and commissioning that have not been corrected at the time of report preparation.
c. Deferred tests that cannot be performed at the time of report preparation.
d. A plan for the completion of Cx activities and training, including climatic and other conditions required for performance of the deferred tests.

I201.9 (I2.9) Final Cx Report.

A final Cx report should be provided by the *Cx provider* and should include the following information:

a. A copy of the final *Cx plan*, including *FPT* procedures used during the *Cx process*, including measurable criteria for test acceptance.

b. A copy of the final *OPR, BoD*, and design and submittal reviews as required by the *Cx plan* if not included in the submitted systems manual.

c. Results of all evaluations, startup data, *FPT*, and reports by suppliers, contractors, observers, and *Cx providers*.

d. Issue logs and disposition of all deficiencies found during testing, including details of corrective measures used or proposed.

e. Equipment, systems, and assemblies repaired or replaced and adjustments to calibration.

f. Documentation of equipment and systems sequences and settings, which are typically submitted in the final sequence of operation and in the systems manual.

g. A resolution plan identifying all of the issues unresolved and incomplete at the end of the project.

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21_INFORMATIVE APPENDIX J OPTION FOR RESIDENTIAL COMPLIANCE USING THE NATIONAL GREEN BUILDING STANDARD | 2018 2018 International Green Construction Code® (IgCC®) | ICC premiumACCESS

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INFORMATIVE APPENDIX J
OPTION FOR RESIDENTIAL COMPLIANCE USING THE NATIONAL GREEN BUILDING STANDARD

The provisions contained in this appendix are mandatory if specifically referenced and specified, wholly or in part, in the enabling law. The National Green Building Standard is a voluntary consensus standard which applies to the design and construction of residential portions of buildings. The Standard establishes criteria for rating the environmental impact of design and construction practices to achieve conformance with specified performance levels for green residential buildings.

SECTION J101
GENERAL

J101.1 Residential requirements determined by the authority having jurisdiction.

The authority having jurisdiction shall determine if one or more of the following sections apply.

J101.1.1.

Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three stories in height above grade plane with a separate means of egress, their accessory structures, and the site or lot upon which these buildings are located shall comply with ICC/ASHRAE 700–2015 *National Green Building Standard*.

J101.1.2.

Group R-3 residential buildings, their accessory structures, and the site or lot upon which these buildings are located shall comply with ICC/ASHRAE 700–2015 *National Green Building Standard*.

J101.1.3.

Group R-2 and R-4 residential buildings three stories or less in height above grade plane, their accessory structures, and the site or lot upon which these buildings are located shall comply with ICC/ASHRAE 700–2015 *National Green Building Standard*.

J101.1.4.

Group R-2 and R-4 residential buildings four stories or more in height above grade plane, their accessory structures, and the site or lot upon which these buildings are located shall comply with the provisions of this code or ICC/ASHRAE 700–2015 *National Green Building Standard*.

J101.1.5.

Group R-2 and R-4 portions of mixed use buildings shall comply with the provisions of this code or ICC/ASHRAE 700–2015 *National Green Building Standard*. The remainder of the building and the site upon which the building is located shall comply with the provisions of this code.

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22_ANNEX 1 REFERENCED STANDARD REPRODUCTION ANNEX ASHRAE STANDARD 169 | 2018 2018 International Green Construction Code® (IgCC®) | ICC premiumACCESS

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ANNEX 1
REFERENCED STANDARD REPRODUCTION ANNEX
ASHRAE STANDARD 169

(This annex contains normative material from an existing ASHRAE standard that is cited in this code. This annex is not part of this code; its inclusion is merely informative. It is included here to facilitate use of this code.)

Annex 1 contains extractions of material from ASHRAE Standard 169. The table below lists where in Standard 189.1 this material is referenced and whether it is referenced normatively or informatively.

STANDARD 189.1 SECTION	ANNEX 1 FIGURE/TABLE/SECTION	ASHRAE STANDARD 169 MATERIAL	STATUS IN STANDARD 189.1
Appendix A	Figure Annex1-1	Figure B-1, Climate Zones for United States Counties	Informative
Appendix A	Section Annex1-1	Section A3 Climate Zone Definitions	Normative
Appendix A	Table Annex1-1	Table A-3 Thermal Climate Zone Definitions	Normative

***Informative Note*:** Section references that appear in this annex are references to sections or appendices in ANSI/ASHRAE Standard 169.

SECTION ANNEX 101 (SECTION ANNEX 1-1) ASHRAE STANDARD 169-2013, SECTION A3: CLIMATE ZONE DEFINITIONS

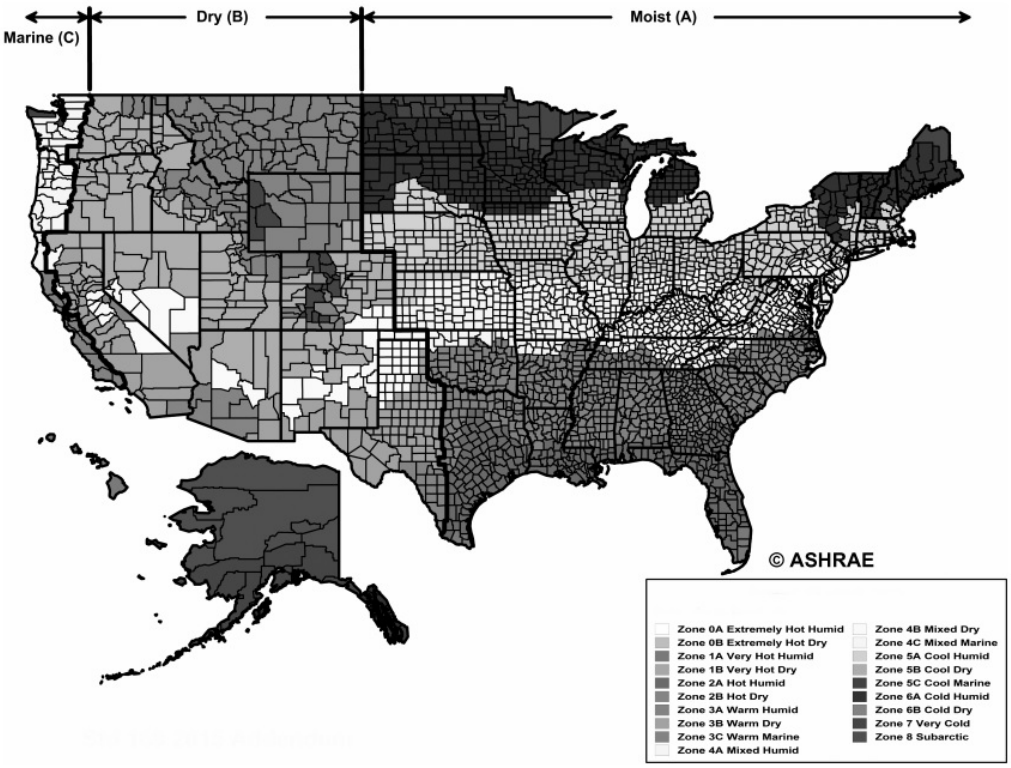

FIGURE ANNEX 101.1 (FIGURE ANNEX 1-1)
ASHRAE STANDARD 169-2013, FIGURE B-1: CLIMATE ZONES FOR UNITED STATES COUNTIES.

TABLE ANNEX 101.1 (TABLE ANNEX1-1)
ASHRAE STANDARD 169-2013, TABLE A-3: THERMAL CLIMATE ZONE DEFINITIONS

THERMAL ZONE	NAME	I-P UNITS	SI UNITS
0	Extremely hot	10,800 < CDD50°F	6000 < CDD10°C
1	Very hot	9000 < CDD50°F ≤ 10,800	5000 < CDD10°C ≤ 6000
2	Hot	6300 < CDD50°F ≤ 9000	3500 < CDD10°C ≤ 5000
3	Warm	CDD50°F ≤ 6300 and HDD65°F ≤ 3600	CDD10°C < 3500 and HDD18°C ≤ 2000
4	Mixed	CDD50°F ≤ 6300 and 3600 < HDD65°F ≤ 5400	CDD10°C < 3500 and 2000 < HDD18°C ≤ 3000
5	Cool	CDD50°F ≤ 6300 and 5400 < HDD65°F ≤ 7200	CDD10°C ≤ 3500 and 3000 < HDD18°C ≤ 4000
6	Cold	7200 < HDD65°F ≤ 9000	4000 < HDD18°C ≤ 5000
7	Very cold	9000 < HDD65°F ≤ 12600	5000 < HDD18°C ≤ 7000
8	Subarctic/arctic	12600 < HDD65°F	7000 < HDD18°C

SECTION A301 (A3.) CLIMATE ZONE DEFINITIONS

To determine the climate zones for locations not listed in this code, use the following information to determine climate zone numbers and letters.

Determine the thermal climate zone, 0–8, from Table Annex 101.1 (1-1), using the heating and cooling degree-days for the location.

Determine the moisture zone (Marine, Dry or Humid):

a. If monthly average temperature and precipitation data are available, use the Marine, Dry, and Humid definitions below to determine the moisture zone (C, B, or A).
b. If annual average temperature information (including degree-days) and annual precipitation (i.e. annual mean) are available, use the following to determine the moisture zone:
    1. If thermal climate zone is 3 and CDD50°F ≤ 4500 (CDD10°C ≤ 2500), climate zone is Marine (3C).
    2. If thermal climate zone is 4 and CDD50°F ≤ 2700 (CDD10°C ≤ 1500), climate zone is Marine (4C).
    3. If thermal climate zone is 5 and CDD50°F ≤ 1800 (CDD10°C ≤ 1000), climate zone is Marine (5C).

    Use the third criteria below for determining the Dry/Humid threshold if not Marine (C).
c. If only degree-day information is available, use the following to determine the moisture zone:
    1. If thermal climate zone is 3 and CDD50°F ≤ 4500 (CDD10°C ≤ 2500), climate zone is Marine (3C).
    2. If thermal climate zone is 4 and CDD50°F ≤ 2700 (CDD10°C ≤ 1500), climate zone is Marine (4C).
    3. If thermal climate zone is 5 and CDD50°F ≤ 1800 (CDD10°C ≤ 1000), climate zone is Marine (5C).

It is not possible to assign Dry/Humid splits in this case.

Marine (C) Zone Definition—Locations meeting all four of the following criteria:

a. Mean temperature of coldest month between 27°F (–3°C) and 65°F (18°C);
b. Warmest month mean < 72°F (22°C);
c. At least four months with mean temperatures over 50°F(10°C); and
d. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.

Dry (B) Definition—Locations meeting the following criteria:

a. Not Marine (C);
b. If 70% or more of the precipitation, *P*, occurs during the high sun period, then the dry/humid threshold is:

$$P < 0.44 \times (T - 7) \quad \text{(I-P)}$$

$$P < 20.0 \times (T + 14) \quad \text{(SI)}$$

c. If between 30% and 70% of the precipitation, *P*, occurs during the high sun period, then the dry/humid threshold is:

$$P < 0.44 \times (T - 19.5) \quad \text{(I-P)}$$

$$P < 20.0 \times (T + 7) \quad \text{(SI)}$$

d. If 30% or less of the precipitation, *P*, occurs during the high sun period, then the dry/humid threshold is:

$$P < 0.44 \times (T - 32) \quad \text{(I-P)}$$

$$P < 20 \times T \quad \text{(SI)}$$

where:

***P* = annual precipitation, in. (mm).**

***T* = annual mean temperature, °F (°C).**

Summer or high sun period = April through September in the Northern Hemisphere and October through March in the Southern Hemisphere.

Winter or cold season = October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.

Humid (A) Definition—Locations that are not Marine (C) and not Dry (B).

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