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Comparison of Standard 90.1-2010 and the 2012 IECC with Respect to Commercial Buildings

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Prepared by Pacific Northwest National Laboratory
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Acronyms and Abbreviations

AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
BECP	Building Energy Codes Program
bhp	brake horsepower
DCV	demand control ventilation
DDC	Direct Digital Control (Systems)
DOE	U.S. Department of Energy
EPACT	Federal Energy Policy Act of 1992
hp	horsepower
HSPF	Heating Seasonal Performance Factor
HVAC	Heating, Ventilating and Air-Conditioning
IBC	International Building Code
ICC	International Code Council
IECC	International Energy Conservation Code
IESNA	Illuminating Engineering Society of North America
IPLV	Integrated Part Load Value
LPD	lighting power density
LPG	liquefied petroleum gas
NAECA	National Appliance Energy Conservation Act
NEC	National Electrical Code
NPLV	Non-Standard Part Load Value
O&M	Operation and Maintenance (Manual)
PF	Projection Factor
SEP	State Energy Program
SHGC	solar heat gain coefficient
SPF	sprayed polyurethane foam
VAV	variable air volume
VLT	Visible Light Transmittance
w.g.	water gauge
WWR	Window-to-Wall Ratio

Introduction

The U.S. Department of Energy's (DOE's) Building Energy Codes Program (BECP) has been asked by some states and energy code stakeholders to address the comparability of the 2012 International Energy Conservation Code® (2012 IECC) as applied to commercial buildings and ANSI/ASHRAE/IESNA[1] Standard 90.1-2010 (hereinafter referred to as Standard 90.1-10). An assessment of comparability will help states respond to and implement conditions specified in the State Energy Program (SEP) Formula Grants American Recovery and Reinvestment Act Funding Opportunity, Number DE-FOA-0000052, and eliminate the need for the states individually or collectively to perform comparative studies of the 2012 IECC and Standard 90.1-10.

The funding opportunity announcement contains the following conditions:

(2) The State, or the applicable units of local government that have authority to adopt building codes, will implement the following:

(A) A residential building energy code (or codes) that meets or exceeds the most recent International Energy Conservation Code, or achieves equivalent or greater energy savings.

(B) A commercial building energy code (or codes) throughout the State that meets or exceeds the ANSI/ASHRAE/IESNA Standard 90.1–2007, or achieves equivalent or greater energy savings[2].

(C) A plan to achieve 90 percent compliance with the above energy codes within eight years. This plan will include active training and enforcement programs and annual measurement of the rate of compliance.

With respect to item (B) above, many more states, regardless of the edition date, directly adopt the IECC than Standard 90.1-10[3]. This is predominately because the IECC is a model code and part of a coordinated set of model building codes that state and local government have historically adopted to regulate building design and construction. In addition the IECC contains provisions address energy efficiency for low-rise residential construction. This report compares the 2012 IECC to Standard 90.1-10 with the intent of helping states address whether the adoption and application of the 2012 IECC for commercial buildings can be considered equivalent to the adoption and application of Standard 90.1-10. Based on this document, states adopting the 2012 IECC, which is the document cited in (A), above, for residential construction, can also determine if they are in compliance with the above provisions for commercial buildings in (B) above and if their code "…meets or exceeds the ANSI/ASHRAE/IESNA Standard 90.1-07." Both Standard 90.1-10 and the 2012 IECC exceed the energy savings of Standard 90.1-2007 and the 200 IECC so their adoption would meet or exceed the codes and standards referenced in the American Recovery and Reinvestment Act.

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[1] American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning/Illuminating Engineering Society of North America

[2] There is a difference in the metrics of "meet or exceed" and "achieves equivalent or greater energy savings." This document is intended to assist the former by offering insight into the comparability of the provisions of Standard 90.1-10 and the 2012 IECC as applied to commercial buildings.

[3] View State Adoption Maps at: https://www.energycodes.gov/states/maps/commercialStatus.stm

Key Differences

There are numerous differences between the two documents that would impact the issue of "meets or exceeds" on a building-by-building basis that are identified throughout the comparison. The application of the subject documents (the 2012 IECC or Standard 90.1-10) on a state-wide basis for all commercial construction, as intended by the Recovery Act-SEP, allows for a review of "meets or exceeds" on an aggregate basis as opposed to assessing whether the "meets or exceeds" test is satisfied for each and every building in a particular state. As such, while the detailed comparison can be consulted, the key differences from that comparison are the most informative and influential in helping a state address a "meets or exceeds" metric.

Key differences between the 2012 IECC and Standard 90.1-10 are listed below based on building system type (i.e. building envelope, mechanical and lighting system). Because no energy analysis to quantify the magnitude of any difference in annual energy use or peak demand was conducted, the differences are generally presented in the order in which they would be found reading both documents (e.g. envelope, mechanical, and lighting).

Building Envelope

- Standard 90.1-010 has a specific designation of semi-heated space and comparable thermal envelope provisions for assemblies associated with such spaces that are less rigorous than those for heated spaces. The 2012 IECC has no such designation and, therefore, treats all semi-heated spaces as heated spaces. The result is that spaces that would be semi-heated under Standard 90.1-10 generally have more rigorous thermal envelope requirements under the 2012 IECC. The provisions in both documents for heated spaces are generally identical, but in some cases one or the other is slightly more/less stringent.
- ASHRAE 90.1-2010 allows up to 40% WWR and 5% skylights as a percentage of roof area. The 2012 IECC allows 30% WWR and 3% skylights as a percentage of roof area. If a building is greater than 30% WWR or greater than 3% skylights as a percentage of roof area, then in referencing Standard 90.1-10 the 2012 IECC is equal to Standard 90.1-10 for thermal envelope provisions. For others with lower percentages both documents need to be evaluated to with respect to selected definitions, climate zones, and specific criteria. If all of these are equal, then the documents are equal. If not, then the differences need to be identified to allow an assessment of the energy implications of the difference. One key area in which they are not equal is in what constitutes a wall. In Standard 90.1-10, for the purposes of determining the percentage of wall that is vertical fenestration, aside from the skylight difference, Standard 90.1-10 uses "walls" as the denominator; they are defined as both above- and below-grade walls. Chapter 5 of the 2012 IECC, in addressing the WWR, considers only above-grade walls. This means that a building under the 2012 IECC is more likely to reach the 30% WWR limitation, especially when considering the skylight definition, faster than a similar building under Standard 90.1-10 reaching the 30% WWR. This will allow buildings with greater than 30% WWR that cannot comply with the prescriptive requirements under 2012 IECC to comply with the prescriptive requirements under 90.1-10. This does not necessarily change the end technical requirements in either document, it just means that a building under Chapter 5 is more likely to be referred to Standard 90.1-10.
- Standard 90.1-10 has different provisions for above- and below-grade walls, the latter being generally less stringent. The 2012 IECC is the same in this regard, and the provisions in both documents are

essentially the same, except that under Standard 90.1-10, portions of walls above grade are treated as above grade and portions of the same walls that are below grade are treated as below grade. The 2012 IECC, in contrast, would allow any wall that is up to 15% above grade and 85% or more below grade to be considered entirely a below-grade wall. Similarly, a wall that is more than 15% above grade would be considered entirely an above-grade wall. Depending on the actual basement/first-story configuration of a building, one document or the other could be more or less stringent with respect to insulation on the subject walls. However, because a relatively small fraction (15%) above grade pushes the entire wall toward the more rigorous above-grade criteria under the 2012 IECC, that document may be more stringent on average.

- The provisions of Standard 90.1-10 are more specific for what is required to be inspected than the 2012 IECC.
- *The thermal requirements for opaque assemblies are not always identical between the two documents, although the climate zones are identica*l. In some instances Standard 90.1-10 is less stringent than the 2012 IECC. *This is one area where a state MAY want to conduct additional analysis based on the detailed comparison below and the climate zones found in the state.*
- The thermal requirements for non-opaque assemblies are not always identical between the two documents, although the climate zones are identical. In some instances Standard 90.1-10 is more stringent and in others the 2012 IECC is more stringent. *This is one area where a state MAY want to conduct additional analysis based on the detailed comparison below and the climate zones found in the state.*
- Both documents have thermal requirements that differ between residential and non-residential buildings; however, because the term "residential" is defined differently in the two documents, it is more likely that some buildings or portions of buildings would be considered residential under Standard 90.1-10 and commercial under the 2012 IECC. Thus, in some instances, a building built to the 2012 IECC would have more rigorous thermal envelope provisions than if built to ASHRAE Standard 90.1-10. For example Standard 90.1-10 defines patient rooms as residential where as the 2012 IECC would consider these spaces commercial occupancies because they are not considered dwelling units. Hotel/motel guest rooms are also considered residential in Standard 90.1-10 but are considered commercial in the 2012 IECC.
- The 2012 IECC allows an increase in vertical fenestration area if at least 50% if the conditioned floor area is in a daylit zone and the lighting is controlled by automatic daylighting controls. The provision also allows for a reduction in the SHGC stringency above 6 ft from the floor to allow for an increase in visible transmittance. The 2012 IECC also allows for an increase in skylight area with use of daylighting controls in daylit areas under skylights. There are no such provisions in ASHRAE 90.1-10 thus a building built to the 2012 IECC may have more stringent requirements for building greater than 30% WWR for vertical fenestration and over 3% for skylights due to the additional controls requirement.
- ASHRAE 90.1-10 contains a provision on fenestration orientation that indirectly limits the fenestration area on the east and west facades by requiring that the south façade has a greater fenestration area that that on the east or west façade. No similar provisions appear in the 2012 IECC making Standard 90.1-10 more stringent for fenestration placement. The 2012 IECC allows a less stringent SHGC for skylights to allow for greater visible transmittance to increase the daylighting potential. This is only allowed under skylights with automatic daylighting controls. In some climate

zones this will make the 2012 IECC less stringent than Standard 90.1-10 for all skylight-to-roof percentages.

- Dynamic glazing is only addressed for vertical fenestration in the 2012 IECC while ASHRAE also addresses its use for skylights.

Mechanical Systems

- Standard 90.1-10 exempts spaces with a design load of 15,000 Btu/h for cooling systems only. The 2012 IECC places a lower limit of 6,800 Btu/h for the exception and addresses both heating and cooling.
- Provisions in ASHRAE 90.1-10 appear to be more stringent than those of the 2012 IECC for thermostatic setback controls and, as such, systems constructed to the former would be more likely to be operated to save additional energy. High temperature limit differs between the two documents. The 2012 IECC has a limit of 85˚F where Standard 90.1-10 set the limit at 90˚F or higher to prevent humidity. ASHRAE exempts radiant systems from this requirement.
- Both codes require automatic start capabilities. However, Standard 90.1-10 includes a minimum size below which the controls are not required, where as the e 2012 IECC as no lower limit on equipment size. The requirement for demand control ventilation is triggered with smaller occupant loads in the 2012 IECC making it more stringent than Standard 90.1-10.
- For high pressure duct systems, the air leakage requirement of 4 cfm/100 ft2 in ASHRAE 90.1-10 is more stringent than the 6 cfm/100 ft2 in the 2012 IECC.
- The 2012 IECC requires system commissioning based on the total building HVAC capacity for heating and cooling systems regardless of floor area. Standard 90.1-10 bases commissioning requirements on floor area. The 2012 IECC will typically require commissioning on smaller buildings (assuming 400 ft2/ton of cooling) because of the total building threshold of 480,000 Btu/hr output for space cooling. This will equate an approximately 16,000 ft2 building verses a building of 50,000 ft2 under Standard 90.1-10.
- The 2012 IECC requires economizers for systems greater than or equal to 33,000 Btu/h which is more stringent than Standard 90.1-10. The 2012 IECC provides equipment efficiency trade-offs for all systems located in 3 climate zones where as Standard 90.1-10 provides those trade-offs in all climate zones where economizers are required.
- The 2012 IECC contains requirements for fan motors starting at 7.5 horsepower. The requirements in ASHRAE don't start until 10 horsepower.

  Provisions for balancing hydronic systems are more stringent in the 2012 IECC, using a cutoff of a 5 hp motor rather than the 10 hp cutoff used in Standard 90.1-10.

Lighting Systems

- Standard 90.1-10 is more stringent in dealing with lighting alterations, allowing only 10 percent of the lighting to be altered before compliance must be demonstrated for the lighting system.
- The prescriptive lighting power limits are more stringent in Standard 90.1-10. Both the 2012 IECC and Standard 90.1-10 contain a Space-by-Space method as an alternative to the by-building-type

prescriptive tables. A building complying via the Space-by-Space method may be subject to more or less rigorous requirements depending on the specifics of space types contained within the building.

- Standard 90.1-10 contains a provision for lighting control in parking garages that is not contained in the 2012 IECC.
- Standard 90.1-10 includes more specific time periods when exterior lighting will be shut off and also includes signage which is exempt in the 2012 IECC by stating that only exterior lights not designated for dusk to dawn operation must comply.

Other

- The 2012 IECC contains a section on additional efficiency package options that does not appear in Standard 90.1-10.

2012 IECC	Standard 90.1-10	Comparative Notes
	Chapter 2: Scope	
C101.2 Scope. This code applies to *commercial buildings* and the buildings sites and associated systems and equipment.	**2.1**. This standard provides: **a.** Minimum energy-efficient requirements for the design, construction, and a plan for operation and maintenance of; 1. New buildings and their systems 2. New portions of buildings and their systems 3. New systems and equipment in existing buildings 4. New equipment or building systems specifically identified in the standard that are part of industrial or manufacturing processes. **b.** Criteria for determining compliance with these requirements.	Standard 90.1-10 is equivalent to the 2012 IECC in scope of the code and the type of projects that it is applied to.
C101.2 Scope. This code applies to *commercial buildings* and the buildings sites and associated systems and equipment. **C202 COMMERICAL BUILDING.** For this code, all buildings tht are not included in the definition of "Residential Buildings".	**2.2** The provisions of this standard do not apply to: **a.** Single-family houses, multi-family structures of three stories or fewer above grade, manufactured houses (mobile homes), and manufactured houses (modular), or **b.** Buildings that use neither electricity nor fossil fuel.	The scope of Standard 90.1-2010 is identical to that of the 2012 IECC for the type of buildings that are covered.
No Comparable Provision	**2.3** Where specifically noted in this standard, certain other buildings or elements of buildings shall be exempt.	No comparable language occurs in the 2012 IECC.
C101.3 Intent. This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.	**2.4** This standard shall not be used to circumvent any safety, health, or environmental requirements.	Both Standard 90.1-2010 and the 2012 IECC contain similar language dealing with safety, health or environmental requirements.
C401.2 Application. Commercial buildings shall comply with one of the following: 1. The requirements of ANSI/ASHRAE/IESNA 90.1. 2. The requirements of Sections C402, C403, C404 and C405. In addition, commercial buildings shall comply with either Section C406.2, C406.3 or C406.4. 3. The requirements of Section C407, C402.4, C403.2, C404, C405.2, C405.3, C405.4, C405.6 and C405.7. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.	**4.1.1.1 New Buildings.** New buildings shall comply with the standard as described in Section 4.2.	Meet either all of Chapter 4 of the 2012 IECC OR Standard 90.1-10. The 2012 IECC contains requirements for the building envelope, lighting system, service water heating and mechanical systems. ASHRAE 90.1-2010 also has requirements for the systems mentioned above but also has requirements covering power and other equipment and therefore a broader scope than the 2012 IECC.

2012 IECC	Standard 90.1-10	Comparative Notes
C401.2.1 Application to existing buildings. Additions, alterations and repairs to existing buildings shall comply with one of the following: 1. Sections C402, C403, C404 and C405; or 2. ANSI/ASHRAE/IESNA 90.1.	**4.1.1.2 Additions to Existing Buildings.** An extension or increase in the floor area or height of a building outside of the existing building envelope shall be considered additions to existing buildings and shall comply with the standard as described in Section 4.2. **4.1.1.3 Alterations of Existing Buildings.** Alterations of existing buildings shall comply with the standard as described in Section 4.2. **4.1.1.4 Replacement of Portions of Existing Buildings.** Portions of a building envelope, heating, ventilating, air-conditioning, service water heating, power, lighting, and other systems and equipment that are being replaced shall be considered as alterations of existing buildings and shall comply with the standard as described in Section 4.2.	Provisions in both 2012 IECC and ASHRAE 90.1-10 require that additions, alterations, and repairs to existing buildings must comply with the current code. The requirements for alterations within 90.1 are a little more detailed than those in the 2012 IECC.
C401.2.1 Application to existing buildings. Additions, alterations and repairs to existing buildings shall comply with one of the following: 1. Sections C402, C403, C404 and C405; or 2. ANSI/ASHRAE/IESNA 90.1.	**4.2.1.2 Additions to Existing Buildings.** Additions to existing buildings shall comply with either the provisions of Section 5, 6, 7, 8, 9, and 10 or Section 11. **Exception**: When an addition to an existing building cannot comply by itself, trade-offs will be allowed by modification to one or more of the existing components of the existing building. Modeling of the modified components of the existing building and addition shall employ the procedures of Section 11; the addition shall not increase the energy consumption of the existing building plus the addition beyond the energy that would be consumed by the existing building plus the addition if the addition alone did comply. **4.2.1.3 Alterations of Existing Buildings.** Alterations of existing buildings shall comply with the provisions of Sections 5, 6, 7, 8, 9, and 10, provided, however, that nothing in this standard shall require compliance with any provision of this standard if such compliance will result in the increase of energy consumption of the building. Exceptions: a. A building that has been specifically designated as historically significant by the adopting authority or is listed in The National Register of Historic Places of has been determined to be eligible for listing by the US Secretary of the Interior and need not comply with these requirements. b. Where one or more components of an existing building or portions thereof are being replaced, the annual energy consumption of the comprehensive design shall not be	Provisions in both 2012 IECC and ASHRAE 90.1-10 require that additions, alterations, and repairs to existing buildings must comply with the current code. ASHRAE 90.1-2010 allows some flexibility in allowing modifications to the existing building to offset portions of the addition that do not comply with the code. The 2012 IECC would require that both the addition and the existing building be brought up to compliance with the code if this approach was taken making the 2012 IECC more stringent. ASHRAE 90.1-2010 allows flexibility in meeting the alteration requirements by allowing portions of energy using features to not specifically meet the provisions of 90.1-2010 but instead for the proposed alteration to use no more energy than an alteration that just meets the 90.1-2010 requirements. The IECC does not provide this flexibility as it would require an alteration to meet the provisions of Chapter 4 Prescriptive or the ECB approach.

2012 IECC	Standard 90.1-10	Comparative Notes
	greater than the annual energy consumption of a substantially identical design, using the same energy types, in which the applicable requirements of Sections 5, 6, 7, 8, 9, and 10, as provided in Section 4.2.1.3, and such compliance is verified by a design professional, by the use of any calculation methods acceptable to the authority having jurisdiction.	
DEFINITIONS **C201.1 Scope.** Unless stated otherwise, the following words and terms in this code shall have the meanings indicated in this chapter. **C201.2 Interchangeability.** Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular. **C201.3 Terms defined in other codes.** Terms that are not defined in this code but are defined in the *International Building Code*, *International Fire Code*, *International Fuel Gas Code*, *International Mechanical Code*, *International Plumbing Code* or the *International Residential Code* shall have the meanings ascribed to them in those codes. **C201.4 Terms not defined.** Terms not defined by this chapter shall have ordinarily accepted meanings such as the context implies.	**3.1 General** Certain terms, abbreviations, and acronyms are defined in this section for the purposes of this standard. These definitions are applicable to all sections of this standard. 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 upon American standard English language usage as documented in an unabridged dictionary accepted by the adopting authority.	Standard 90.1-2010 and the 2012 IECC are consistent in how they handle definitions for terms. The 2012 IECC references other International codes if definitions are not contained in the IECC. A comparison of relevant definitions occurs throughout this document as relevant to the issue being compared.
DESIGN CONDITIONS **Chapter 3**	**5.1.4 Climate.** Determine the climate zone for the location. For US locations, the procedure in Section 5.1.4.1. For international locations, follow the procedures in Section 5.1.4.2. **5.1.4.1 United States Locations**. Use Figure B-1 or Table B-1 in Appendix B to determine the required climate zone. Exception: If there are recorded historical climatic data available for a construction site, they may be used to determine compliance if approved by the building official. **5.1.4.2 International Locations.** For location in Canada that are listed in Table B-2 in Appendix B, use this table to determine the required climate zone number and, when a climate zone letter is also required, use Table B-4 and the	The climate zones appear to be the same between the 2012 IECC and Standard 90.1-10 and, as such, all else being the same, the criteria would be the same between the commercial provisions of the 2012 IECC and Standard 90.1-10.

2012 IECC	Standard 90.1-10	Comparative Notes
	Major Climate Type Definitions in Appendix B to determine the letter (A, B, or C). For locations in other international countries that are listed in Table B-3, use this table to determine the required climate zone number and, when a climate zone letter is also required, use Table B-4 and the Major Climate Type Definitions in Appendix B to determine the letter (A, B, or C). For all international locations that are not listed either in Table B-2 or B-3, use Table B-4 and the Major climate Type Definitions in Appendix B to determine both the climate zone letter and number.	
ADMINISTRATIVE REQUIREMENTS **Chapter 1**	**Compliance** **Chapter 4**	
C101.4 Applicability. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.	**4.1.5 Other Laws.** The provisions of this standard shall not be deemed to nullify any provisions of local, state or federal law. Where there is conflict between a requirement of this standard and such other law affecting construction of the building, precedence shall be determined by the authority having jurisdiction.	The 2012 IECC provides guidance where there are conflicts between the 2012 IECC and other International or adopted codes. Standard 90.1-2010 provides similar guidance but references state or local laws that can be interpreted as locally adopted health/life safety codes.
C101.4.1 Existing buildings. Except as specified in this chapter, this code shall not be used to require the removal, *alteration* or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.	**No Comparable Provision**	Standard 90.1-2010 does not contain a specific provision that compares with the 2012 IECC for existing buildings.
C101.4.2 Historic buildings. Any building or structure that is listed in the State or National Register of Historic Places; designated as a historic property under local or state designation law or survey; certified as a contributing resource with a National Register listed or locally designated historic district; or with an opinion or certification that the property is eligible to be listed on the National or State Registers of Historic Places either individually or as a contributing building to a historic district by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, are exempt from this code.	**4.2.1.3 Alterations of Existing Buildings.** Alterations of existing buildings shall comply with the provisions of Sections 5, 6, 7, 8, 9, and 10, provided, however, that nothing in this standard shall require compliance with any provision of this standard if such compliance will result in the increase of energy consumption of the building. Exceptions: a. A building that has been specifically designated as historically significant by the adopting authority or is listed in The National Register of Historic Places of has been determined to be eligible for listing by the US Secretary of the Interior and need not comply with these requirements.	Standard 90.1-10 and the 2012 IECC both contain exemptions for existing buildings that are listed on a historic register. The provisions are similar.
C101.4.3 Additions, alterations, renovations or repairs. Additions, alterations, renovations or repairs to an	**.2.1.3 Alterations of Existing Buildings.** Alterations of existing buildings shall comply with the provisions of Sections 5, 6, 7, 8, 9, and 10, provided, however, that nothing	The 2012 IECC requires that all additions, alterations or repairs comply with the provisions of the code as they relate to new construction. Because Standard

2012 IECC	Standard 90.1-10	Comparative Notes
existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing building or building system to comply with this code. Additions, alterations, renovations or repairs shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code if the addition alone complies or if the existing building and addition comply with this code as a single building. **Exception:** The following need not comply provided the energy use of the building is not increased: 1. Storm windows installed over existing fenestration. 2. Glass only replacements in an existing sash and frame. 3. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation. 4. Construction where the existing roof, wall or floor cavity is not exposed. 5. Reroofing for roofs where neither the sheathing nor the insulation is exposed. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing. 6. Replacement of existing doors that separate *conditioned space* from the exterior shall not require the installation of a vestibule or revolving door, provided, however, that an existing vestibule that separates a *conditioned space* from the exterior shall not be removed, 7. Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power. 8. Alterations that replace only the bulb and ballast within the existing luminaires in a space provided that the *alteration* does not increase the installed interior lighting power.	in this standard shall require compliance with any provision of this standard if such compliance will result in the increase of energy consumption of the building. Exceptions: a. A building that has been specifically designated as historically significant by the adopting authority or is listed in The National Register of Historic Places of has been determined to be eligible for listing by the US Secretary of the Interior and need not comply with these requirements. **b.** Where one or more components of an existing building or portions thereof are being replaced, the annual energy consumption of the comprehensive design shall not be greater than the annual energy consumption of a substantially identical design, using the same energy types, in which the applicable requirements of Sections 5, 6, 7, 8, 9, and 10, as provided in Section 4.2.1.3, and such compliance is verified by a design professional, by the use of any calculation methods acceptable to the authority having jurisdiction.	90.1-2010 is a reference document in the 2012 IECC it is typically interpreted that the provisions in the 2012 IECC will dictate when an addition, alteration or repair must comply with the code. The code user can then choose to use either Standard 90.1-10 or the 2012 IECC to demonstrate compliance with that particular provision by first referencing C401.2 Application. Section C101.4 of the 2012 IECC would dictate that an exemption for compliance with the an alteration found in the Standard 90.1-10 that was not found in the 2012 IECC would be superseded if both the 2012 IECC and Standard 90.1-10 were in effect.
C101.4.4 Change in occupancy or use. Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code. Where the use in a	**No Comparable Provision**	There is not comparable provision in Standard 90.1-10 that would require a commercial building to demonstrate compliance with the LPD's due to a chance in occupancy.

2012 IECC	Standard 90.1-10	Comparative Notes
space changes from one use in Table C405.5.2(1) or (2) to another use in Table C405.5.2(1) or (2), the installed lighting wattage shall comply with Section C405.5.		
C101.4.5 Change in space conditioning. Any nonconditioned space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.	**4.1.1.5 Changes in Space Conditioning.** Whenever unconditioned or semiheated spaces in a building are converted to conditioned spaces, such conditioned spaces shall be brought into compliance with all the applicable requirements of this standard that would apply to the building envelope, heating, ventilating, air-conditioning, service water heating, power, lighting, and other systems and equipment of the space as if the building were new.	Standard 90.1-10 and the 2012 IECC are identical in their requirements.
C101.4.6 Mixed occupancy. Where a building includes both *residential* and *commercial* occupancies, each occupancy shall be separately considered and meet the applicable provisions of IECC—Commercial Provisions or IECC—Residential Provisions.	**No Comparable Provision**	Standard 90.1-10 does not a specific provision that is comparable to the 2012 IECC but does exempt low-rise residential construction from the requirements of the Standard. There is no guidance provided on mixed occupancies within Standard 90.1-10.
SECTION C402 **BUILDING ENVELOPE REQUIREMENTS**	**5. BUILDING ENVELOPE**	
C402.1 General (Prescriptive). C402.1 General (Prescriptive). The building thermal envelope shall comply with Section C402.1.1. Section C402.1.2 shall be permitted as an alternative to the *R*-values specified in Section C402.1.1.	**5.1.1 Scope.** Section 5 specifies requirements for the building envelope.	Standard 90.1-10 and the 2012 IECC both specify requirements for the building envelope. Both have similar requirements except that that Standard 90.1-10 also has separate requirements for semi-heated spaces that are less stringent than the requirements for fully conditioned space.
C402.1.1 Insulation and fenestration criteria. The *building thermal envelope* shall meet the requirements of Tables C402.2 and C402.3 based on the climate zone specified in Chapter 3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *R*-values from the "Group R" column of Table C402.2. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the *R*-values from the "All other" column of Table C402.2. Buildings with a vertical fenestration area or skylight area that exceeds that allowed in Table C402.3 shall comply with the building envelope provisions of ANSI/ASHRAE/IESNA 90.1.	**5.5.1** For a *conditioned space*, the exterior building envelope shall comply with either the "nonresidential" or "residential" requirements in Table 5.5-1 through 5.5-8 for the appropriate climate.	ASHRAE 90.1-2010 allows up to 40% WWR and 5% skylights as a percentage of roof area. The 2012 IECC allows 30% WWR and 3% skylights as a percentage of roof area. If a building is greater than 30% WWR or greater than 3% skylights as a percentage of roof area, then in referencing Standard 90.1-10 the 2012 IECC is equal to Standard 90.1-10 for thermal envelope provisions. One key area in which they are not equal is in what constitutes a wall. In Standard 90.1-10, for the purposes of determining the percentage of wall that is vertical fenestration, aside from the skylight difference, Standard 90.1-10 uses "walls" as the denominator; they are defined as both above- and below-grade walls. Chapter 5 of the 2012 IECC, in addressing the WWR, considers only above-grade walls. This means that a building under the 2012 IECC is more likely to reach

2012 IECC	Standard 90.1-10	Comparative Notes
		the 30% WWR limitation, especially when considering the skylight definition, faster than a similar building under Standard 90.1-10 reaching the 30% WWR. This will allow buildings with greater than 30% WWR that cannot comply with the prescriptive requirements under 2012 IECC to comply with the prescriptive requirements under 90.1-10. This does not necessarily change the end technical requirements in either document, it just means that a building under Chapter 5 is more likely to be referred to Standard 90.1-10.
No Comparable Provision	**5.5.2** If a building contains any semiheated space or unconditioned space, then the semi- exterior building envelope shall comply with the requirements for semiheated space in Tables 5.5-1 through 5.5-8 for the appropriate climate. (See Figure 5.1.) **5.7.2 Submittal Document Labeling of Space Conditioning Categories.** For buildings that contain spaces that will be only semiheated or unconditioned, and compliance is sought using the "semiheated" envelope criteria, such spaces shall be clearly indicated on the floor plans that are submitted for review.	Standard 90.1-2010 has provisions for semi-heated spaces that are not included in the 2012 IECC. Because the 2012 IECC allows the use of Standard 90.1-2010 as compliance option both the code and standard are similar.
C402.1.2 *U*-factor alternative. An assembly with a *U*-factor, *C*-factor, or *F*-factor equal or less than that specified in Table C402.1.2 shall be permitted as an alternative to the *R*-value in Table C402.2. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *U*-factor, *C*-factor, or *F*-factor from the "Group R" column of Table C402.1.2. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the *U*-factor, *C*-factor or *F*-factor from the "All other" column of Table C402.1.2.	**5.5.3 Opaque Areas** For all opaque surfaces except doors, compliance shall be demonstrated by one of the following two methods; a. Minimum rated R-values of insulation for the thermal resistance of the added insulation in framing in framing cavities and continuous insulation only. Specifications listed in Normative Appendix A for each class of construction shall be used to determine compliance. b. Maximum U-Factor, C-Factor, or F-factor for the entire assembly. The values for typical construction assemblies listed in Normative Appendix A shall be used to determine compliance. **Exceptions to Section 5.5.3** a. For assemblies significantly different from those in Appendix A, calculations shall be performed in accordance with the procedures required in Appendix A. b. For multiple assemblies within a single class of	The 2012 IECC prescriptive provisions and performance alternatives appear to be mirrored in Standard 90.1-10 with the exception that the required or maximum/minimum values between the two documents are different. Standard 90.1-10 also contains a "library of U-factors" in Appendix A that is not contained in the IECC. These U-factors can be used as an alternative in complying with the U-factor requirements in Standard 90.1-10. It is possible that these values can be used to comply with the U-factor requirements in the IECC because Standard 90.1-10 is a reference document. See below for a discussion of the differences. As shown below, in discussing the specific differences associated with the thermal envelope and some of the definitions, there are many distinct details to be considered. The intent of both documents in allowing tradeoffs is the same, but because the basis for the tradeoffs is different in some cases between Chapter 4 of the 2012 IECC and

2012 IECC	Standard 90.1-10	Comparative Notes
	construction for a single space-conditioning category, compliance shall be shown for either (1) the most restrictive requirement or (2) an area-weighted average U-Factor, C-Factor, or F-Factor.	Standard 90.1-10, the two documents result in different minimum acceptable designs under the alternative approaches to compliance.
C303.1.1 Building thermal envelope insulation. An *R* value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be *listed* on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed* on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site. **C303.1.1.1 Blown or sprayed roof/ceiling insulation.** The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m^2) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be *listed* on certification provided by the insulation installer. **C402.2 Specific insulation requirements (Prescriptive).** Opaque assemblies shall comply with Table C402.2. Where two or more layers of continuous insulation board are used in a construction assembly, the continuous insulation boards shall be installed in accordance with Section C303.2. If the continuous insulation board manufacturer's installation	**5.8.1.1 Labeling of Building Envelope Insulation.** The rated R-value shall be clearly identified by an identification mark applied by the manufacturer to each piece of building envelope insulation. **Exception:** When insulation does not have such an identification mark, the installer of such insulation shall provide a signed and dated certification for the installed insulation listing the type of insulation, the manufacturer, the rated R-value, and, where appropriate, the initial installed thickness, the settled thickness, and the coverage area. **5.8.1.2 Compliance with Manufacturers' Requirements.** Insulation materials shall be installed in accordance with manufacturers' recommendations and in such a manner as to achieve rated R-value of insulation. **Exception:** Where metal building roof and metal building wall insulation is compressed between the roof or wall skin and the structure. **5.9.1.3 Loose-Fill Insulation Limitation.** Open-blown or poured loose-fill insulation shall not be used in attic roof spaces when the slope of the ceiling is more than three in twelve. **5.8.1.4 Baffles** When eave vents are installed, baffling of the vent openings shall be provided to deflect the incoming air above the surface of the insulation. **5.8.1.9 Extent of Insulation.** Insulation shall extend over the full component are to the required rated R-value of insulation, U-Factor, C-Factor, or F-Factor, unless otherwise allowed in Section 5.8.1. **5.8.1.10 Joints in rigid insulation.** Where two or more layers of rigid insulation board are used in a construction assembly, the edge joints between each layer of boards shall be staggered.	The provisions in Standard 90.1-10 are a little more detailed than those in the 2012 IECC, but for all intents and purposes, because both documents refer back to the manufacturer's instructions, they could be considered comparable. Both Standard 90.1-10 and the 2012 IECC require that joints be staggered when two or more layers of insulation are installed.

2012 IECC	Standard 90.1-10	Comparative Notes
instructions do not address installation of two or more layers, the edge joints between each layer of continuous insulation boards shall be staggered.		
No Comparable Provision	**5.8.1.5 Substantial Contact** Insulation shall be installed in a permanent manner in substantial contact with the inside surface in accordance with manufacturers' recommendations for the framing system used. Flexible batt insulation installed in floor cavities shall be supported in a permanent manner by supports no greater than 24 in. on center. **Exception:** Insulation materials that rely on air spaces adjacent to reflective surfaces for their rated performance.	The 2012 IECC has no comparable provision for ensuring that the insulation is in substantial contact. Section C303.2 of the 2012 IECC does require that insulation be installed per the manufacturers installation instructions but it is not certain that this provision is comparable to Standard 90.1-2010.
C303.2.1 Protection of exposed foundation insulation. Insulation applied to the exterior of basement walls, crawlspace walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (153 mm) below grade.	**5.8.1.7 Insulation Protection.** Exterior insulation shall be covered with a protective material to prevent damage from sunlight, moisture, landscaping operations, equipment maintenance, and wind. 5.8.1.7.1 In attics and mechanical rooms, a way to access equipment that prevents damaging or compressing the insulation shall be provided. 5.8.1.7.2 Foundation vents shall not interfere with the insulation.	Both Standard 90.1-10 and the 2012 IECC are comparable for insulation protection. The 2012 IECC does not have comparable provisions for installation requirements in attics and mechanical rooms or for insulation installed in crawlspaces.
No Comparable Provision	**5.8.1.7.3** Insulation materials in ground contact shall have a water absorption rate no greater than 0.3% when tested in accordance with ASTM C272.	The 2012 IECC has no comparable provision.
C103.3 Examination of documents. The *code official* shall examine or cause to be examined the accompanying construction documents and shall ascertain whether the construction indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances. **C104.1 General.** Construction or work for which a permit is required shall be subject to inspection by the *code official*. **C104.2 Required approvals.** Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the *code official*. The *code official*, upon notification, shall make the requested inspections and shall either indicate	**4.2.2.2 Supplemental Information.** Supplemental information necessary to verify compliance with this standard, such as calculations, worksheets, compliance forms, vendor literature, or other data, shall be made available when required by the building official. **4.2.4 Inspections.** All building construction, additions, or alterations subject to the provisions of this standard shall be subject to inspection by the building official, and all such work shall remain accessible and exposed for inspection purposes until approved in accordance with the procedures specified by the building official. Items for inspection include at least the following: a. wall insulation after the insulation and vapor retarder are in place but not before the concealment.	The provisions of Standard 90.1-10 are more specific for what is required to be inspected than the 2012 IECC.

2012 IECC	Standard 90.1-10	Comparative Notes
the portion of the construction that is satisfactory as completed, or notify the permit holder or his or her agent wherein the same fails to comply with this code. Any portions that do not comply shall be corrected and such portion shall not be covered or concealed until authorized by the *code official*. **C104.3 Final inspection.** The building shall have a final inspection and not be occupied until *approved*. **C104.4 Reinspection.** A building shall be reinspected when determined necessary by the *code official*. **C104.5 Approved inspection agencies.** The *code official* is authorized to accept reports of *approved* inspection agencies, provided such agencies satisfy the requirements as to qualifications and reliability. **C104.6 Inspection requests.** It shall be the duty of the holder of the permit or their duly authorized agent to notify the *code official* when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this code. **C104.7 Reinspection and testing.** Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made so as to achieve compliance with this code. The work or installation shall then be resubmitted to the *code official* for inspection and testing. **C104.8 Approval.** After the prescribed tests and inspections indicate that the work complies in all respects with this code, a notice of approval shall be issued by the *code official*. **C104.8.1 Revocation.** The *code official* is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this code wherever the certificate is issued in error, or on the basis of incorrect information supplied, or where it is determined that the building or structure, premise, or portion thereof is in	b. Roof/ceiling insulation after roof/insulation is in place but before concealment. c. Slab/foundation wall after slab/foundation insulation is in place, but before concealment. d. Fenestration after all glazing materials are in place e. Continuous air barrier after installation but before concealment f. Mechanical systems and equipment and insulation after installation but before concealment g. Electrical equipment and systems after installation but before concealment	

2012 IECC	Standard 90.1-10	Comparative Notes
violation of any ordinance or regulation or any of the provisions of this code.		
No Comparable Provision	**4.2.2.3 Manuals.** Operation and maintenance information shall be provided to the building owner. This information shall include, but not be limited to, the information specified in Section 6.7.2.2, 8.7.2, and 9.7.2.2.	The 2012 IECC does require operation and maintenance manuals for the mechanical systems but does not require them for the service water heating or lighting systems. Also Standard 90.1 allows the operation and maintenance manuals to be provided within 90 days of system acceptance. The 2012 IECC requires that they be provided by the certificate of occupancy.
C303.1 Identification. Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.	**4.2.3 Labeling of Material and Equipment.** Materials and equipment shall be labeled in a manner that will allow for a determination of their compliance with the applicable provisions of this standard.	Standard 90.1-10 and the 2012 IECC are identical in their requirements.
C402.2 Specific insulation requirements (Prescriptive). Opaque assemblies shall comply with Table C402.2. Where two or more layers of continuous insulation board are used in a construction assembly, the continuous insulation boards shall be installed in accordance with	**5.5.1.** For conditioned space, the exterior building envelope shall comply with either the "nonresidenetiaol" or "residential" requirements in Tables 5.5.-1 through 5.5-8 for the appropriate climate. **5.5.2.** If a building contains any semiheated space or unconditioned space, then the semi-exterior building envelope shall comply with the requirements for semiheated space in Tables 5.5-1 through 5.5-8 for the appropriate climate (see Figure 5.1).	Standard 90.1-10 and the 2012 IECC use a similar table format for displaying the opaque envelope requirements in the code. In general the requirements in the 2012 IECC for the opaque envelope are slightly more stringent in for several assembly types in several climate zones. Fenestration requirements will vary in stringency based on climate zone and percentage of either vertical or horizontal fenestration. There is also a subtle difference associated with the opaque thermal requirements. Section 502.1.1 of the 2012 IECC refers the residential provisions to Use Group R buildings, which is a defined term in the International Building Code (IBC). Standard 90.1-10 defines residential as spaces in buildings used primarily for living and sleeping and then gives some examples. These documents are not identical and it is possible that some buildings considered residential in one document could be considered commercial in the other and vice versa. This would impact the equivalency of the two documents as it relates to certain residential buildings. For instance, patient rooms in hospitals would be part of a Use Group I for the IBC and, as such, would be subject to the commercial provisions of the 2012 IECC, but as defined in Standard 90.1-10, the envelope associated with the patient rooms would have to meet the more stringent residential provisions of the envelope tables.

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C402.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.2, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less. **Exceptions:** 1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U*-factor is equivalent to the same assembly with the *R*-value specified in Table C402.2. 2. Unit skylight curbs included as a component of an NFRC 100 rated assembly shall not be required to be insulated. Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.	**5.5.3.1 Roof Insulation** All roofs shall comply with the insulation values specified in Tables 5.5-1 through 5.5-8. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5.0, whichever is less. **5.8.1.8 Location of Roof Insulation.** The roof insulation shall not be installed on a suspended ceiling with removable ceiling panels.	Standard 90.1-10 is less stringent for metal building roof systems in all climate zones and is also less stringent in Zones 4 and colder for roof insulation placed entirely above the roof deck. Attic insulation requirements are also more stringent in the 2012 IECC for several of the colder climate zones. The documents seem to be equivalent with respect to not allowing insulation on suspended ceilings to count toward compliance, although the 2012 IECC says it cannot be counted and Standard 90.1-10 says it cannot be installed on the panels.
C402.2.1.1 Roof solar reflectance and thermal emittance. Low-sloped roofs, with a slope less than 2 units vertical in 12 horizontal, directly above cooled *conditioned spaces* in Climate Zones 1, 2, and 3 shall comply with one or more of the options in Table C402.2.1.1. **Exceptions:** The following roofs and portions of roofs are exempt from the requirements in Table C402.2.1.1: 1. Portions of roofs that include or are covered by: 1.1. Photovoltaic systems or components. 1.2. Solar air or water heating systems or components. 1.3. Roof gardens or landscaped roofs. 1.4. Above-roof decks or walkways. 1.5. Skylights. 1.6. HVAC systems, components, and other opaque objects mounted above the roof. 2. Portions of roofs shaded during the peak sun angle on the summer solstice by permanent features of the	**5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance.** Roofs, in climate zones 1 through 3 shall have one of the following: a. a minimum three-year-aged solar reflectance of 0.55 when tested in accordance with ASTM C1549 or ASTM E1918, and in addition, a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with ASTM C1371 of ASTM E408. b. A minimum three-year-aged Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 BTU/h-ft2. c. Increased roof insulation levels found in Table 5.5.3.1.2 **Exceptions:** a. Ballasted roofs with a minimum stone ballast of 17lbs/ft2 or 23 lbs/ft2 pavers. b. Vegetated Roof Systems that contain a minimum	IECC includes information in the footnotes for materials lacking initial tested values or three-year aged values. Standard 90.1-10 also allows the use of increased roof/ceiling insulation to comply with the cool roof requirements. Standard 90.1-10 allows the use of the CRRC-1 Standard that is not referenced in the 2012 IECC. Standard 90.1-10 also contains several exceptions that are not in the 2012 IECC e.g. low sloped metal building roofs in climate zones 2 and 3 and asphaltic membranes in climate zones 2 and 3. Otherwise provisions look to be the same.

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building, or by permanent features of adjacent buildings. 3. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot (psf) (74 kg/m^2) or 23 psf (117 kg/m^2) pavers. 4. Roofs where a minimum of 75 percent of the roof area meets a minimum of one of the exceptions above.	thickness of 2.5 in. of growing medium and covering a minimum of 75% of the roof area with durable plantings. c. Roofs, where a minimum of 75% of the roof area: 1. Is shaded during the peak sun angle on June 21st by permanent components or features of the building, or 2. Is covered by off-set photovoltaic arrays, building-integrated photovoltaic arrays, or solar air or water collectors, or 3. Is permitted to be interpolated using a combination of parts i and ii above. d. Steep sloped roofs. e. Low sloped metal building oofs in climate zones 2 and 3. f. Roofs over ventilated attics or roofs over semi-heated spaces or roofs over conditioned spaces that are not cooled spaces. g. Asphaltic membranes in climate zones 2 and 3. The values for three-year-aged solar reflectance and three-year-aged thermal emmitance shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the Cool Roof Rating Council CRRC-1 Product Rating Program, and shall be labeled and certified by the manufacturer.	
C402.2.2 Classification of walls. Walls associated with the building envelope shall be classified in accordance with Section C402.2.2.1 or C402.2.2.2.		
C402.2.2.1 Above-grade walls. Above-grade walls are those walls covered by Section C402.2.3 on the exterior of the building and completely above grade or walls that are more than 15 percent above grade.	**Chapter 3: Definition of above grade walls:** A wall that is not a below-grade wall.	There is a difference between the 2012 IECC and 90.1-10. It is possible under the former to have just under 15% or less of a wall be above grade, yet it would be allowed to be insulated as a below-grade wall. In Standard 90.1-10 only those portions of the wall that are entirely below grade must meet the below-grade provisions. A look at this definition and how it affects differences in wall area for the purpose of determining WWR indicates that under the 2012 IECC the WWR is based on above-grade wall area and in Standard 90.1-10 it is based on the gross wall area measured on the exterior

2012 IECC	Standard 90.1-10	Comparative Notes
		face of the wall from the top of the floor to the bottom of the roof. For a below-grade wall one would assume that the floor could be the floor of the below-grade story/basement and the exterior face would be that on the building exterior whether exposed to outdoor air or not.
C402.2.2.2 Below-grade walls. Below-grade walls covered by Section C402.2.4 are basement or first-story walls associated with the exterior of the building that are at least 85 percent below grade.	**Chapter 3: Definition of below grade walls:** The portion of a wall in the building envelope that is entirely below the finish grade and in contact with the ground.	There is a difference between the 2012 IECC and 90.1-10. It is possible under the former to have just under 15% or less of a wall be above grade, yet it would be allowed to be insulated as a below-grade wall. In Standard 90.1-10 only those portions of the wall that are entirely below grade must meet the below-grade provisions. A look at this definition and how it affects differences in wall area for the purpose of determining WWR indicates that under the 2012 IECC the WWR is based on above-grade wall area and in Standard 90.1-10 it is based on the gross wall area measured on the exterior face of the wall from the top of the floor to the bottom of the roof. For a below-grade wall one would assume that the floor could be the floor of the below-grade story/basement and the exterior face would be that on the building exterior whether exposed to outdoor air or not.
C402.2.4 Thermal resistance of below-grade walls. The minimum thermal resistance (*R*-value) of the insulating material installed in, or continuously on, the below-grade walls shall be as specified in Table C402.2, and shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the floor, whichever is less.	**5.5.3.3 Below-Grade Wall Insulation.** Below-grade walls shall have a rated R-value of insulation no less than the insulation values specified in Tables 5.5-1 through 5.5-8. **Exception:** Where framing, including metal and wood studs is used, compliance shall be based on the maximum assembly C-Factor.	See above.
C402.2.5 Floors over outdoor air or unconditioned space. The minimum thermal resistance (*R*-value) of the insulating material installed either between the floor framing or continuously on the floor assembly shall be as specified in Table C402.2, based on construction materials used in the floor assembly. "Mass floors" shall include floors weighing not less than: 1. 35 psf (170 kg/m^2) of floor surface area; or 2. 25 psf (120 kg/m^2) of floor surface area if the	**5.5.3.4 Floor Insulation:** All floors shall comply with the insulation values specified in Tables 5.5-1 through 5.5-8.	Floors are not defined in the 2012 IECC, so it is not clear what would constitute a wall or floor if certain exterior envelope components were not vertical or horizontal. Standard 90.1-10 defines floors as surfaces associated with the thermal envelope that are less than 60 degrees from vertical. As such, it is possible in Standard 90.1-10 to have some surfaces that would likely be called floors, which under the 2012 IECC would be considered walls and therefore subject to less stringent requirements. Also, mass floors are defined

2012 IECC	Standard 90.1-10	Comparative Notes
material weight is not more than 12 pcf (1,900 kg/m^3).		in Standard 90.1-10 based on heat capacity, and not weight per unit area of floor. It would not be possible to make a precise comparison on this issue without looking at the weights and heat capacity of different floor-assembly materials.
C402.2.6 Slabs on grade. Where the slab on grade is in contact with the ground, the minimum thermal resistance (*R*-value) of the insulation around the perimeter of unheated or heated slab-on-grade floors shall be as specified in Table C402.2. The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil. **Exception:** Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.	**5.5.3.5 Slab-On-Grade Floor Insulation.** All slab-on-grade floors, including heated slab-on-grade floors and unheated slab-on-grade floors, shall comply with the insulation values specified in Tables 5.5-1 through 5.5-8.	Standard 90.1-10 defines slabs on grade as those above grade or below grade within 24 inches of finished grade. Appendix A of Standard 90.1-10 also provides details for the installation of the insulation which, to some degree, parallel the provisions in the 2012 IECC. The 2012 IECC does not define slabs on grade but does state that slab-on-grade floors greater than 24 inches below grade shall be exempt from perimeter insulation which is consistent with Standard 90.1-10. Based on this exception the slab edge insulation requirements would be applied identically under both Standard 90.1-10 and the 2012 IECC. The 2012 IECC is more stringent for heated slabs on all but Climate Zone 3.
C402.2.7 Opaque doors. Opaque doors (doors having less than 50 percent glass area) shall meet the applicable requirements for doors as specified in Table C402.2 and be considered as part of the gross area of above-grade walls that are part of the building envelope.	**5.5.3.6 Opaque Doors.** All opaque doors shall have U-factor not greater than that specified in Tables 5.5-1 through 5.5-8.	Under the 2012 IECC, doors that are less than 50% glass are opaque doors. The door provisions in Standard 90.1-10 are the same. So in both documents doors greater than or equal to 50% glazing are treated in total as part of the fenestration of the building and subject to those provisions. Those that are <50% glazed are clearly considered all opaque in the 2012 IECC. Standard 90.1-10 requires the opaque door area to comply with the door requirements and the glazing to comply with the fenestration requirements for door with less than 50% glass.
C402.2.8 Insulation of radiant heating systems. Radiant panels, and associated U-bends and headers, designed for sensible heating of an indoor space through heat transfer from the thermally effective panel surfaces to the occupants or indoor space by thermal radiation and natural convection and the bottom surfaces of floor structures incorporating radiant	**6.4.4.1.5 Radiant Floor Heating.** The bottom surfaces of floor structures incorporating radiant heating shall be insulated with a minimum of R-3.5. Adjacent envelope insulation counts toward this requirement.	Both Standard 90-1-10 and the 2012 IECC have the same requirement for radiant floor heating insulation requirements. Standard 90.1-10 and the 2012 IECC both contain requirements that address radiant heating systems. The 2012 IECC requires insulation to be placed on the back of radiant panels and this requirement is more

2012 IECC	Standard 90.1-10	Comparative Notes
heating shall be insulated with a minimum of R-3.5 (0.62 $m^2/K \times W$).		appropriately placed in the mechanical requirements of the code. The Standard 90.1-10 requirements are for floor assemblies that include radiant systems. The requirements are not equivalent in how they address radiant systems.
C402.3 Fenestration (Prescriptive). Fenestration shall comply with Table C402.3. Automatic daylighting controls specified by this section shall comply with Section C405.2.2.3.2.		
C402.3.1 Maximum area. The vertical fenestration area (not including opaque doors and opaque spandrel panels) shall not exceed 30 percent of the gross above-grade wall area. The skylight area shall not exceed 3 percent of the gross roof area.	**5.5.4.2.1 Vertical Fenestration Area.** The total vertical fenestration area shall be less than 40% of the gross wall area. **Exception:** Vertical fenestration complying with Exception (c) to Section 5.5.4.4.1 **5.5.4.2.2 Maximum Skylight Fenestration Area:** The total skylight area shall not exceed 5% of the gross roof area.	One would need to look at definitions of fenestration. Standard 90.1-10 sets the WWR at 40% with the IECC setting the requirement at 30% WWR. The 2012 IECC allows the WWR to be increased to 40% for Climate Zones 1 to 6 if not less than 50% of the floor area is in daylight zone and daylighting controls are used in the zones. Beyond 40% WWR Standard 90.1-10 allows the use of an envelope trade off option or using an ECB approach. The IECC allows the use of an ECB approach for building greater than 30% WWR (40% if taking the daylighting option) or using Standard 90.1-10. The skylight limitation in Standard 90.1-10 is 5% and in the 2012 IECC is 3% that can be increased to 5% if daylighting controls are installed in all daylit zones. The 2012 IECC also allows the SHGC and U-factor to be increased for skylights over daylight zones that are controlled by automatic daylighting controls. Both Standard 90.1-10 and the 2012 IECC offer options for buildings that have greater than 3% and 5% skylight roof area respectively. The 2012 IECC can use Standard 90.1-10 as an option. Standard 90.1-10 includes separate requirements for glass and plastic skylights where as the 2012 IECC has one U-factor and SHGC requirements for all skylights in each climate zone. In general the 2012 IECC has more stringent skylight U-factor requirements and similar SHGC requirements for up to 2% of the roof area then the Standard has more stringent requirements.
C402.3.1.1 Increased vertical fenestration area with daylighting controls. In Climate Zones 1 through 6, a maximum of 40 percent of the gross above-grade wall area shall be permitted to be vertical fenestration,	**No Comparable Provision**	There is no provision withinStandard 90.1-10 that compares to this allowance. The allowance allows an increase in vertical fenestration area providing 50% of the conditioned floor area is in daylight zone and that

2012 IECC	Standard 90.1-10	Comparative Notes
provided: 1. No less than 50 percent of the conditioned floor area is within a daylight zone; 2. Automatic daylighting controls are installed in daylight zones; and 3. Visible transmittance (VT) of vertical fenestration is greater than or equal to 1.1 times solar heat gain coefficient (SHGC). **Exception:** Fenestration that is outside the scope of NFRC 200 is not required to comply with Item 3.		the lights are controlled by automatic daylighting controls. The provision does allow for a reduction in SHGC stringency for fenestration above 6 feet from the floor to allow for an increase in VT.
	5.5.4.5 Fenestration Orientation. The vertical fenestration area shall meet the following requirement: *A Sε A W* and *A Sε A E* Where As= south oriented vertical fenestration area (oriented less than or equal to 45 degrees of true south) North oriented vertical fenestration area (oriented An=less than or equal to 45 degrees of true north) Aw = west oriented vertical fenestration area (oriented less than 30 degrees of true west) east oriented vertical fenestration area (oriented lessAe = less than 30 degrees of true east). In southern hemisphere, replace As with An in the formulae above. Exceptions to 5.5.4.5: a. Vertical fenestration that complies with the exception to 5.5.4.4.1 (c). b. Buildings that have an existing building or existing permanent infrastructure within 20 ft to the south (north in the southern hemisphere) which is at least half as tall as the proposed building. c. 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). Alterations and additions with no increase in vertical fenestration area.	There is no comparable provision in the 2012 IECC. This provision indirectly limits the fenestration area on the east and west facades by requiring that the south façade has a greater fenestration area than on the west or east façade.

2012 IECC	Standard 90.1-10	Comparative Notes
C402.3.1.2 Increased skylight area with daylighting controls. The skylight area shall be permitted to be a maximum of 5 percent of the roof area provided automatic daylighting controls are installed in daylight zones under skylights.	**No Comparable Provision**	Standard 90.1-10 does not include a comparable code provision for increasing skylight area to 5% with the use of daylighting controls. Standard 90.1-10 allows up to 5% with an increased level of U-factor and SHGC.
C402.3.2 Minimum skylight fenestration area. In an enclosed space greater than 10,000 square feet (929 m^2), directly under a roof with ceiling heights greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, storage, gymnasium/exercise center, convention center, automotive service, manufacturing, non-refrigerated warehouse, retail store, distribution/sorting area, transportation, or workshop, the total daylight zone under skylights shall be not less than half the floor area and shall provide a minimum skylight area to daylight zone under skylights of either: 1. Not less than 3 percent with a skylight VT of at least 0.40; or 2. Provide a minimum skylight effective aperture of at least 1 percent determined in accordance with Equation 4-1. Skylight Effective Aperature=(0.85 x Skylight Area x Skylight VT x WF) / (Daylight zone under skylight) where: Skylight area = Total fenestration area of skylights. Skylight VT = Area weighted average visible transmittance of skylights. WF = Area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 feet (610 mm), or 0.7 if light well depth is 2 feet (610 mm) or greater. Light well depth = Measure vertically from the underside of the lowest point of the skylight glazing to the ceiling plane under the skylight. **Exception:** Skylights above daylight zones of enclosed spaces are not required in: 1. Buildings in climate zones 6 through 8. 2. Spaces where the designed *general lighting* power densities are less than 0.5 W/ft^2 (5.4 W/m^2). 3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on at least	**5.5.4.2.3 Minimum Skylight Fenestration Area.** In any enclosed space in a building that is four stories or less and that is: a. 5000 ft2 and greater and, b. Directly under a roof with ceiling heights greater than 15 ft, and c. One of the following space types: office, lobby, atrium, concourse, corridor, non-refrigerated warehouse or storage, gymnasium/exercise center, convention center, automotive service, manufacture, retail, distribution/sorting area, transportation, or workshop, the total daylight area under skylights shall be a minimum of half the floor area and either: d. Provide a minimum skylight area to daylight area under skylights of 3% with a skylight VT of at least 0.40 e. or provide a minimum skylight effective aperture of at least 1%. These skylights shall have a glazing material diffuser with a measured haze value greater than 90% when tested in accordance to ASTM D1003. General lighting in the daylight area shall be controlled as described in Section 9.4.1.5.	The minimum skylight based requirements for Standard 90.1-10 and the 2012 IECC are similar except that Standard 90.1-10 requires the installation of skylights for spaces 5,000 ft^2 and greater and the 2012 IECC requires skylights for spaces 10,000 ft^2 or greater. but there are more exceptions under Standard 90.1-10. The exceptions allow skylight area to be reduced if sidelighting can be used and also if shading exists that reduces the effectiveness of the daylighting. Both the 2012 IECC and Standard 90.1-10 contain requirements for haze factor. The 2012 IECC limits the requirement based on occupancy type and exterior shading of the skylight.

2012 IECC	Standard 90.1-10	Comparative Notes
half of the roof over the enclosed area for more than 1,500 daytime hours per year between 8 am and 4 pm. 4. Spaces where the daylight zone under rooftop monitors is greater than 50 percent of the enclosed space floor area. **C402.3.2.2 Haze factor.** Skylights in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store, and distribution/sorting area spaces shall have a glazing material or diffuser with a measured haze factor greater than 90 percent when tested in accordance with ASTM D 1003. **Exception:** Skylights designed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles, or the geometry of skylight and light well need not comply with Section C402.3.2.2.		
C402.3.2.1 Lighting controls in daylight zones under skylights. All lighting in the daylight zone shall be controlled by multilevel lighting controls that comply with Section C405.2.2.3.3. **Exception:** Skylights above daylight zones of enclosed spaces are not required in: 1. Buildings in Climate Zones 6 through 8. 2. Spaces where the designed *general lighting* power densities are less than 0.5 W/ft^2 (5.4 W/m^2). 3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on at least half of the roof over the enclosed area for more than 1,500 daytime hours per year between 8 am and 4 pm. 4. Spaces where the daylight zone under rooftop monitors is greater than 50 percent of the enclosed space floor area.	**9.4.1.5 Automatic Daylighting controls for Toplighting.** When the total daylight area under skylights plus the total daylight area under rooftop monitors in an enclosed space exceeds 900ft^2, the lamps for general lighting in the daylight area shall be separately controlled by at least one multilevel photocontrol (including continuous dimming devices) having the following characteristics: a. the light sensor for the photocontrol shall be remote from where calibration adjustments are made. b. The calibration adjustment shall be readily accessible, and c. The multilevel photocontrol shall reduce electric lighting in response to available daylight with at least once control step that is between 50% and 70% of design lighting power and another control step that is no greater than 35% of the design power. **Exceptions:** a. Daylighted areas under skylights where it is documented that existing adjacent structures or natural objects block direct beam sunlight for more than 1500 daytime hours per year between 8 a.m. and 4 p.m. b. Daylighted areas where the skylight effective aperture (EA) is less than 0.006 (0.6%). c. Buildings in climate zone 8 with daylight areas totaling	Both Standard 90.1-10 and the 2012 IECC require automatic daylighting controls when skylights are required for top lighting. Standard 90.1-10 places a requirement for automatic controls for all spaces > 900ft^2 under toplights. The 2012 IECC makes automatic controls a requirement when skylights are required to be installed but not for buildings with less than or equal to 3% skylight to roof area where skylights are not required.

2012 IECC	Standard 90.1-10	Comparative Notes
	less than 1,500 ft^2 in an enclosed space.	
C402.3.3 Maximum *U*-factor and SHGC. For vertical fenestration, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table C402.3, based on the window projection factor. For skylights, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table C402.3. The window projection factor shall be determined in accordance with Equation 4-2. *PF = A/B* **(Equation 4-2)** where: *PF*= Projection factor (decimal). *A* = Distance measured horizontally from the furthest continuous extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing. *B* = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device. Where different windows or glass doors have different *PF* values, they shall each be evaluated separately.	**5.5.4.3 Fenestration U-Factor.** Fenestration shall have a U-factor not greater than that specified in Tables 5.5-1 through 5.5-8 for the appropriate fenestration area. **5.5.4.4 Fenestration Solar Heat Gain Coefficient (SHGC)** **5.5.4.4.1 SHGC of Vertical Fenestration.** Vertical fenestration shall have an SHGC not greater than that specified for "all" orientations in Tables 5.5-1 through 5.5-8 for the appropriate total vertical fenestration area. **Exceptions:** a. For demonstrating compliance for vertical fenestration shaded by opaque permanent projections that will last as long as the building itself, the SHGC in the proposed building shall be reduced by using the multipliers in Table 5.5.4.4.1. Permanent projections consisting of open louvers shall be considered to provide shading, provided that no sun penetrates the louvers during the peak sun angle of June 21. b. For demonstrating compliance for vertical fenestration shaded by partially opaque permanent projections (e.g., framing with glass or perforated metal) that will last as long as the building itself, the PF shall be reduced by multiplying it by a factor of Os, which is derived as follows: $$Os = (Ai \cdot Oi) + (Af \cdot Of)$$ Where O_s = percent opacity of the shading device A_i = percent of the area of the shading device that is a partially opaque infill O_i = percent opacity of the infill—for glass $Oi = (100\% - Ts)$, where T_s is the solar transmittance as determined in accordance with NFRC 300; for perforated or decorative metal panels O_i = percentage of solid material	A comparison of the 2012 IECC and Standard 90.1-10 indicates that the former has no distinction between residential, commercial, or semi-heated or unconditioned space for glazing. It only covers the building thermal envelope, which is defined as enclosing conditioned and unconditioned space. With respect to semi-heated space in Standard 90.1-10, such spaces would be considered conditioned by the 2012 IECC and, as such, there are climate zones in which the glazing provisions would be more stringent in the 2012 IECC because there is no distinction between conditioned and semi-heated space. A quick comparison of vertical fenestration criteria finds that the 2012 IECC is typically more stringent than the U-factor requirements in Standard 90.1-10. The 2012 IECC has three fenestration categories – fixed, operable or entrance doors. Standard 90.1-2010 includes 4 categories – non-metal framing, metal framing including curtain wall/storefront, metal framing entrance doors and metal framing all other. The 2012 IECC U-factor requirements are more stringent compared to all of the categories under Standard 90.1-10 up through Climate Zone 3. For Climate Zones 4 through 8 the requirements in the 2012 IECC are more stringent for all metal window products but less stringent when compared to nonmetal framed products. The 2012 IECC is more stringent in all climate zones compared to semi-heated spaces. Both Standard 90.1-10 and the 2012 IECC use the identical SHGC requirements for all climate zones for vertical fenestration but uses slightly different criteria for allowing trade-offs using overhangs as projection factors. Both the 2012 IECC and Standard 90.1-2010 include a multiplier table based on the projection factor. The 2012 IECC includes credit for two ranges of projection factors where as Standard 90.1-10 provides multipliers for 10 different projection factors and also includes a methodology for determining the PF for a partially opaque overhang. For PF Standard 90.1-10 provides a table of multipliers, by orientation

2012 IECC	Standard 90.1-10	Comparative Notes
	A_f = percent of the area of the shading device that represents the framing members O_f = percent opacity of the framing members; if solid, then 100% And then the SHGC in the proposed building shall be reduced by using the multipliers in Table 5.5.4.4.1 for each fenestration product. c. Vertical fenestration that is located on the street side of the street-level story only, provided that 1. the street side of the street-level story does not exceed 20 ft. in height, 2. the fenestration has a continuous overhang with a weighted average PF greater than 0.5, and 3. The fenestration area for the street side of the street-level story is less than 75% of the gross wall area for the street side of the street-level story. When this exception is utilized, 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. No credit shall be given here or elsewhere in the building for not fully utilizing the fenestration area allowed. **5.5.4.4.2 SHGC of Skylights.** Skylights shall have an SHGC not greater than that specified for "all" orientations in Tables 5.5-1 through 5.5-8 for the appropriate total skylight area. **5.8.2.6 Visible Light Transmittance.** VLT shall be determined in accordance with NFRC 200. VLT shall be verified and certified by the manufacturer.	and PF, which allows the SHGC of the proposed glazing to be reduced for the purpose of compliance. Because the PF values are calculated differently between Standard 90.1-10 and the 2012 IECC applying the same overhang to a window may result in either the Standard or the IECC being more or less stringent. The credit for PF values are slightly different where the PF's overlap at 0.2, 0.5 and >0.5 (assume a PF of 1.0). In some cases Standard 90.1-10 is more stringent and in other cases the 2012 IECC is more stringent. In Climate Zone 1 through 3 a PF of .49 will allow an SHGC of 0.33 in Standard 90.1-10 and an SHGC of 0.30 using the 2012 IECC. But applying a PF of 1.0 will allow a PF of 0.39 in the former and 0.40 in the later. This trend is consistent with the other climate zones. The 2012 IECC has very simplified provisions for skylight U-factor and SHGC. In most cases the 2012 IECC is more stringent in the U-factor requirements but less stringent for SHGC when the skylight to roof area exceeds 2% and for skylights installed in residential occupancies.
C402.3.3.2 Increased vertical fenestration SHGC. In Climate Zones 1, 2 and 3, vertical fenestration entirely located not less than 6 feet (1729 mm) above the finished floor shall be permitted a maximum SHGC of 0.40.	**No Comparable Provision**	The allowance for increased SHGC only occurs in the 2012 IECC and is considered daylight glass. This allows a higher VT to be achieved through the daylight glass. Standard 90.1-10 does not include this allowance.

2012 IECC	Standard 90.1-10	Comparative Notes
C402.3.3.3 Increased skylight SHGC. In Climate Zones 1 through 6, skylights shall be permitted a maximum SHGC of 0.60 where located above daylight zones provided with automated daylighting controls.	**5.5.4.4.2 SHGC of Skylights.** Skylights shall have an SHGC not greater than that specified for "all" orientations in Tables 5.5-1 through 5.5-8 for the appropriate total skylight area. **Exception**: Skylights are exempt from SHGC requirements provided they: a. Have a glazing material or diffuser with a measured haze value greater than 90% when tested according to ASTM D1003. b. Have a Skylight VT greater than 0.40, and; c. Have all general lighting in the daylight area under skylights controlled by multilevel photocontrols in accordance with Section 9.4.1.5. d. For dynamic glazing, the minimum SHGC shall be used to demonstrate compliance with this section. Dynamic glazing shall considered separately from other vertical fenestration, and area-weighted averaging with other vertical fenestration that is not dynamic glazing shall not be permitted.	The 2012 IECC allows a less stringent SHGC for skylights to allow for a greater VT to increase the daylighting potential. This is only allowed under skylights with automatic daylighting controls. In some climate zones this will make the 2012 IECC less stringent than Standard 90.1-10 for all skylight to roof percentages.
C402.3.3.4 Increased skylight *U*-factor. Where skylights are installed above daylight zones provided with automatic daylighting controls, a maximum *U*-factor of 0.9 shall be permitted in Climate Zones 1 through 3; and a maximum *U*-factor of 0.75 shall be permitted in Climate Zones 4 through 8.	**No Comparable Provision**	This allowance only occurs in the 2012 IECC and only over daylit zones with automatic daylighting controls.
C402.3.3.5 Dynamic glazing. For compliance with Section C402.3.3, the SHGC for dynamic glazing shall be determined using the manufacturer's lowest-rated SHGC, and the VT/SHGC ratio shall be determined using the maximum VT and maximum SHGC. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.	**5.5.4.4.1.d.** For dynamic glazing, the minimum SHGC shall be used to demonstrate compliance with this section. Dynamic glazing shall considered separately from other vertical fenestration, and area-weighted averaging with other vertical fenestration that is not dynamic glazing shall not be permitted.	Standard 90.1-10 and the 2012 IECC address the use of dynamic glazing identically with similar limitations on use of dynamic glazing (must be considered separately and cannot be used when doing an area weighted average) The 2012 IECC only addresses dynamic glazing for vertical fenestration where as Standard 90.1-10 also addresses it for skylights.
C402.3 Fenestration (Prescriptive). Fenestration shall comply with Table C402.3. Automatic daylighting controls specified by this section shall comply with Section C405.2.2.3.2.	**5.5.4.1 General.** Compliance with U-factors and SHGC shall be demonstrated for the overall fenestration product. Gross wall areas and gross roof areas shall be calculated separately for each space-conditioning category for the purposes of determining compliance.	Standard 90.1-10 is more specific on the allowance of weighted averaging for using fenestration products with different U-factors and SHGC ratings.

2012 IECC	Standard 90.1-10	Comparative Notes
	Exception: If there are multiple assemblies within a single class of construction for a single space-conditioning category, compliance shall be based on an area-weighted average U-factor or SHGC. It is not acceptable to do an area-weighted average across multiple classes of construction or multiple space-conditioning categories.	
C303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled *U*-factor shall be assigned a default *U*-factor from Table C303.1.3(1) or C303.1.3(2). The solar heat gain coefficient (SHGC) and *visible transmittance* (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table C303.1.3(3).	**5.8.2.1 Rating of Fenestration Products.** The U-factor, SHGC, Visible Transmittance (VT), and air leakage rate for all manufactured fenestration products shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council. **5.8.2.2 Labeling of Fenestration Products.** All manufactured fenestration products shall have a permanent nameplate, installed by the manufacturer, listing the U-factor, SHGC, air leakage rate, and where required by the Exception to 5.5.4.4.2, Visible Transmittance (VT). **Exception**: When the fenestration product does not have such nameplate, the installer or supplier of such fenestration shall provide a signed and dated certification for the installed fenestration listing the U-Factor, SHGC, and the air leakage rate. **5.8.2.3 Labeling of Doors**. The U-factor and the air leakage rate for all manufactured doors installed between conditioned space, semi-heated space, unconditioned space, and exterior space shall be identified on a permanent nameplate installed on the product by the manufacturer. **Exception**: When doors do not have a nameplate, the installer or supplier of any such doors shall provide a signed and dated certification for the installed doors listing the U-facto and the air leakage rate. **5.8.2.4 U-factor**. U-factors shall be determined in accordance with NFRC 100. U-factors for skylights shall be determined by a slope of 20 degrees above the horizontal. **Exception:** a. U-factors from Section A8.1 shall be acceptable alternative for determining compliance with the U-factor	The 2012 IECC and Standard 90.1-10 appear to be comparable with respect to fenestration testing and labeling. It does appear, however, that Standard 90.1-10 allows for a credit for low-emissivity coatings on skylights by referencing Section A8.1 and ensuring that the emissivity is determined in accordance with NFRC 300. There is not a similar approach in the 2012 IECC.

2012 IECC	Standard 90.1-10	Comparative Notes
	criteria for skylights. Where credit is being taken for a low-emissivity coating, the emissivity of the coating shall be determined in accordance with NFRC 300. Emissivity shall be verified and certified by the manufacturer. b. U-factors from Section A8.2 shall be acceptable alternative for determining compliance with the U-factor criteria for vertical fenestration. c. U-factors from Section A7 shall be an acceptable alternative for determining compliance with the U-factor criteria for opaque doors. d. For garage doors, ANSI/DASMA105 shall be an acceptable alternative for determining U-factors. **5.4.2 Fenestration and Doors.** Procedures for determining fenestration and door performance are described in Section 5.8.2. Product samples used for determining fenestration performance shall be production line units or representative of units purchased by the consumer or contractor.	
C303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled *U*-factor shall be assigned a default *U*-factor from Table C303.1.3(1) or C303.1.3(2). The solar heat gain coefficient (SHGC) and *visible transmittance* (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table C303.1.3(3).	**5.8.2.5 Solar Heat Gain Coefficient.** SHGC for the overall fenestration area shall be determined in accordance with NFRC 200. **Exceptions:** a. SC of the center-of-glass multiplied by 0.86 shall be an acceptable alternative for determining compliance with the SHGC requirements for the overall fenestration area. SC shall be determined by using a spectral data file determined in accordance with the NFRC 300. SC shall be verified and certified by the manufacturer. b. SHGC of the center-of-glass shall be an acceptable alternative for determining compliance with the SHGC requirements for the overall fenestration area. SHGC shall be determined using a spectral data file determined in accordance with the NFRC 300. SHGC shall be verified and certified by the manufacturer. c. SHGC from Section A8.1 shall be an acceptable alternative for determining compliance with the SHGC criteria for skylights. Where credit is being taken for a low-emissivity coating, the emissivity of the coating shall be determined in accordance with NFRC 300. Emissivity shall be verified and certified by the manufacturer. **d.** SHGC from Section A8.2 shall be an acceptable	The 2012 IECC and Standard 90.1-10 appear to be comparable with respect to fenestration testing and labeling.

2012 IECC	Standard 90.1-10	Comparative Notes
	alternative for determining compliance with the SHGC criteria for vertical fenestration.	
No Comparable Provision	**5.8.2. 3 Labeling of Doors.** The U-factor and the air leakage rate for all manufactured doors, installed between conditioned space, semi-heated space, unconditioned space, and exterior space shall be identified on a permanent nameplate installed on the product by the manufacturer. **Exception:** When doors do not have such a nameplate, the installer or supplier of any such doors shall provide a signed and dated certification for the installed doors listing the U-factor and the air leakage rate.	There is no parallel provision in the 2012 IECC for labeling of doors (defined as having less than 50% glazing and therefore not considered fenestration). Note below that the issue of air infiltration of doors seems to be equitably addressed in both documents. As to the U-factor for doors, the only apparent difference is that Standard 90.1-10 requires a permanent nameplate with the door U-factor while the 2012 IECC does not (but it does for fenestration).
C402.4 Air leakage (Mandatory). The thermal envelope of buildings shall comply with Sections C402.4.1 through C402.4.8. **C402.4.1 Air barriers.** A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.4.1.1 and C402.4.1.2. **Exception:** Air barriers are not required in buildings located in Climate Zones 1, 2 and 3. **C402.4.1.1 Air barrier construction.** The *continuous air barrier* shall be constructed to comply with the following: 1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies. 2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. Air barrier penetrations shall be sealed in accordance with Section C402.4.2. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.	**5.4.3 Air Leakage** **5.4.3. Continuous Air Barrier**. The entire building envelope shall be designed and constructed with a continuous air barrier. **Exceptions to 5.4.3.1:** a. Semiheated spaces in climate zones 1 thru 6. b. Single wythe concrete masonry buildings in climate zone 2B. **5.4.3.1.1 Air Barrier Design**. The air barrier shall be designed and noted in the following manner: a. All air barrier components of each building envelope assembly shall be clearly identified or otherwise noted on construction documents. b. The joints, interconnections, and penetrations of the air barrier components including lighting fixtures shall be detailed or otherwise noted. c. The continuous air barrier shall extend over all surfaces of the building envelope (at the lowest floor, exterior walls, and ceiling or roof). d. The continuous air barrier shall be designed to resist positive and negative pressures from wind, stack effect, and mechanical ventilation. **5.4.3.1.2 Air Barrier Installation.** The following areas of the continuous air barrier in the building envelope shall be	Standard 90.1-10 and the 2012 IECC have similar requirements for continuous air barriers. Air barriers required different areas/climate zones in the two codes. Semi-heated spaces are exempt under Standard 90.1-10. The IECC 1012 exempts Climate Zones 1 – 3 from the continuous air barrier requirement.` IECC explicitly states air barriers may be installed on the interior or exterior. Standard 90.1-10 allows the use of ASTME E1680 that is not mentioned in 2012 IECC.

2012 IECC	Standard 90.1-10	Comparative Notes
3. Recessed lighting fixtures shall comply with Section C404.2.8. Where similar objects are installed which penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier. **Exception:** Buildings that comply with Section C402.4.1.2.3 are not required to comply with Items 1 and 3. **C402.4.1.2 Air barrier compliance options.** A continuous air barrier for the opaque building envelope shall comply with Section C402.4.1.2.1, C402.4.1.2.2, or C402.4.1.2.3. **C402.4.2 Air barrier penetrations.** Penetrations of the air barrier and paths of air leakage shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Joints and seals shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials shall be appropriate to the construction materials being sealed. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.	wrapped, sealed, caulked, gasketed, or taped in an approved manner to minimize air leakage: a. Joints around fenestration and door frames (both manufactured and site-built). b. Junctions between walls and floors, between walls at building corners, between walls and roofs or ceilings. c. Penetrations through the air barrier in building envelope roofs, walls, and floors. d. Building, assemblies used as ducts or plenums. Joints, seams, connections between planes, and other changes in air barrier materials. **5.4.3.1.2 Air Barrier Installation.** The following areas of the continuous air barrier in the building envelope shall be wrapped, sealed, caulked, gasketed, or taped in an approved manner to minimize air leakage: a. Joints around fenestration and door frames (both manufactured and site-built). b. Junctions between walls and floors, between walls at building corners, between walls and roofs or ceilings. c. Penetrations through the air barrier in building envelope roofs, walls, and floors. d. Building assemblies used as ducts of plenums. e. Joints, seams, connections between planes. And other changes in air barrier material.	
C402.4.1.2.1 Materials. Materials with an air permeability no greater than 0.004 cfm/ft^2 (0.02 L/s · m^2) under a pressure differential of 0.3 inches water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 15 shall be deemed to comp with this section provided joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions. 1. Plywood with a thickness of not less than 3/8 inch (10 mm). 2. Oriented strand board having a thickness of not less than 3/8 inch (10 mm). 3. Extruded polystyrene insulation board having a	**5.4.3.1.3 Acceptable Materials and Assemblies.** Continuous air barrier materials and assemblies for the opaque building envelope shall comply with one of the following requirements: a. Materials that have an air permeance not exceeding 0.004 cfm/ft^2 under pressure differential of 0.3 in w.g. (1.57pfs) when tested in accordance with ASTM E 2178. The following materials meet the requirements of 5.4.3.1.3 a: b. Plywood-minimum 3/8 in. c. Oriented strand board-minimum 3/8 in. d. Extruded polystyrene insulation board- minimum ½ in. e. Foil-faced urethane insulation board- minimum ½ in. f. Exterior gypsum sheathing or interior gypsum board- minimum ½ in.	Both Standard 90.1-10 and the 2012 IECC allow the use of meeting materials maximum air leakage criteria by selecting a list a pre-approved material. The 2012 IECC includes open cell spray foam that is not included in Standard 90.1-10.

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thickness of not less than 1/2 inch (12 mm). 4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch (12 mm). 5. Closed cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) having a thickness of not less than 11/2 inches (36 mm). 6. Open cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) and having a thickness of not less than 4.5 inches (113 mm). 7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch (12 mm). 8. Cement board having a thickness of not less than 1/2 inch (12 mm). 9. Built up roofing membrane. 10. Modified bituminous roof membrane. 11. Fully adhered single-ply roof membrane. 12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch (16 mm). 13. Cast-in-place and precast concrete. 14. Fully grouted concrete block masonry. 15. Sheet steel or aluminum.	g. Cement board- minimum ½ in. h. Built up roofing membrane i. Modified bituminous roof membrane j. Fully adhered single-ply roof membrane k. A Portland cement/sand parge, stucco, or gypsum plaster- minimum ½ in. thick l. Cast-in place and precast concrete. m. Sheet metal. **n.** Closed cell 2 lb/ft3 nominal density spray polyurethane foam-minimum 1 in.	
C402.4.1.2.2 Assemblies. Assemblies of materials and components with an average air leakage not to exceed 0.04 cfm/ft^2 (0.2 L/s · m^2) under a pressure differential of 0.3 inches of water gauge (w.g.)(75 Pa) when tested in accordance with ASTM E 2357, ASTM E 1677 or ASTM E 283 shall comply with this section. Assemblies listed in Items 1 and 2 shall be deemed to comply provided joints are sealed and requirements of Section C402.4.1.1 are met. 1. Concrete masonry walls coated with one application either of block filler and two applications of a paint or sealer coating; 2. A Portland cement/sand parge, stucco or plaster minimum 1/2 inch (12 mm) in thickness.	**5.4.3.1.3. Acceptable Materials and Assemblies.** Continuous air barrier materials and assemblies for the opaque building envelope shall comply with one of the following requirements. a. Assemblies of materials and components (sealants, tapes, etc.) that have an average air leakage not to exceed 0.04 cfm/ft2 under a pressure differential of 0.3 in. w.g. (1.57psf) when tested in accordance with ASTM E 2357 ASTM E1677, ASTM E 1680 or ASTM E283; the following assemblies meet the requirements of 5.4.3.1.3 b. b. Concrete masonry walls that are: i. Fully grouted, or Painted to fill the pores.	Both Standard 90.1-10 and the 2012 IECC allow the use of meeting the assemblies maximum air leakage criteria by selecting from a list a pre-approved assemblies.
C402.4.1.2.3 Building test. The completed building shall be tested and the air leakage rate of the *building envelope* shall not exceed 0.40 cfm/ft^2 at a pressure differential of 0.3 inches water gauge (2.0 L/s · m^2 at 75 Pa) in accordance with ASTM E 779 or an equivalent method approved by the code official.	**No Comparable Provision**	The 2012 IECC also allows the use of whole building testing to meet the requirements of this code provision. Standard 90.1-10 does not have that option.

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C402.4.3 Air leakage of fenestration. The air leakage of fenestration assemblies shall meet the provisions of Table C402.4.3. Testing shall be in accordance with the applicable reference test standard in Table C402.4.3 by an accredited, independent testing laboratory and *labeled* by the manufacturer. **Exceptions:** 1. Field-fabricated fenestration assemblies that are sealed in accordance with Section C402.4.1. 2. Fenestration in buildings that comply with Section C402.4.1.2.3 are not required to meet the air leakage requirements in Table C402.4.3.	**5.4.3.2 Fenestration and Doors** Air leakage for fenestration and doors shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283 as specified below. Air leakage shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council, and shall be labeled and certified by the manufacturer. Air leakage shall not exceed: a. 1.0 cfm/ft^2 for glazed swinging entrance doors and revolving doors, tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with with AAMA/ WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283. b. 0.06 cfm/fts for curtainwall and storefront glazing, tested at a pressure of at least 1.57 pounds per square foot (psf) or higher in accordance with NFRC 400 or ASTM E283. c. 0.3 cfm/fts for unit skylights having condensation weepage openings, when tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, of 0.5 cfm/fts when tested at a pressure of at least 6.24 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440. d. 0.4 cfm/fts for nonswinging opaque doors, tested at a pressure of at least 1.57 pounds per square foot (psf) or higher in accordance with with AAMA/DASMA 105, NFRC 400, or ASTM E283. e. 0.2 cfm/ft^2 for all other products when tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 of NFRC 400, 0.3 cfm/fts when tested at a pressure of at least 6.24 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440. **Exception:** a. Field-fabricated fenestration and doors. b. Metal coiling doors in semiheated spaces in climate zones 1 through 6.	The requirements for air leakage for fenestration in Standard 90.1-10 and the 2012 IECC are very similar. Standard 90.1-10 has an exception for metal coiling doors in semiheated spaces. The 2012 IECC has a requirement for rolling doors which would fall under the requirement for nonswinging opaque doors in Standard 90.1-10. The 2012 IECC has an exception for air leakage that allows fenestration to not comply with the maximum air leakage requirements if the building complies with the continuous air barrier requirement using the testing option. Standard 90.1-10 does not have this allowance.
C402.4.4 Doors and access openings to shafts, chutes, stairways, and elevator lobbies. Doors and access openings from conditioned space to shafts, chutes stairways and elevator lobbies shall either meet	**No Comparable Provision**	Standard 90.1-10 does not have a comparable provision for doors and access opening to shaft, chutes, stairways and elevator lobbies.

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the requirements of Section C402.4.3 or shall be gasketed, weatherstripped or sealed. **Exception:** Door openings required to comply with Section 715 or 715.4 of the *International Building Code*; or doors and door openings required by the *International Building Code* to comply with UL 1784 shall not be required to comply with Section C402.4.4.		
C402.4.5 Air intakes, exhaust openings, stairways and shafts. Stairway enclosures and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be provided with dampers in accordance with Sections C402.4.5.1 and C402.4.5.2. **C402.4.5.1 Stairway and shaft vents.** Stairway and shaft vents shall be provided with Class I motorized dampers with a maximum leakage rate of 4 cfm/ft^2 (20.3 L/s · m^2) at 1.0 inch water gauge (w.g.) (249 Pa) when tested in accordance with AMCA 500D. Stairway and shaft vent dampers shall be installed with controls so that they are capable of automatically opening upon: 1. The activation of any fire alarm initiating device of the building's fire alarm system; or 2. The interruption of power to the damper. **C402.4.5.2 Outdoor air intakes and exhausts.** *Outdoor air* supply and exhaust openings shall be provided with Class IA motorized dampers with a maximum leakage rate of 4 cfm/ft^2 (20.3 L/s · m^2) at 1.0 inch water gauge (w.g.) (249 Pa) when tested in accordance with AMCA 500D. **Exceptions:** 1. Gravity (nonmotorized) dampers having a maximum leakage rate of 20 cfm/ft^2 (101.6 L/s · m^2) at 1.0 inch water gauge (w.g.) (249 Pa) when tested in accordance with AMCA 500D are permitted to be used as follows: 1.1. In buildings for exhaust and relief dampers. 1.2. In buildings less than three stories in height above grade. 1.3. For ventilation air intakes and exhaust and relief	**6.4.3.4.1 Stairs and Shaft Vents**. Stair and elevator shaft vents shall be equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke detection systems. **6.4.3.4.2 Shutoff Damper Controls.** All outdoor air intake and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use. Ventilation outdoor air and exhaust /relief dampers shall be capable of automatically shutting off during preoccupancy building warm-up, cool down, and setback, except when ventilation must be supplied to meet code requirements. **Exceptions:** a. Backdraft gravity (nonmotorized) dampers are acceptable for exhaust and relief in buildings less than three stories in height and for ventilation air intakes and exhaust and relief dampers in buildings of any height located in climate zones 1, 2, and 3. Backdraft dampers for ventilation air intakes must be protected from direct exposure to wind. b. Backdraft gravity (nonmotorized) dampers are acceptable in systems with a design outdoor air intake or exhaust capacity of 300 cfm or less. c. Dampers are not required in ventilation or exhaust systems serving unconditioned spaces. Dampers are not required in exhaust systems serving Type 1 kitchen exhaust hoods.	The 2012 IECC provisions apply to vents and other intakes and openings in the building envelope while Standard 90.1-10 applies to all such vents, intakes, and openings. Beyond that, the scope of each document appears to be comparable. On the issue of rate of leakage, the 2012 IECC and Standard 90.1-10 are identical for all climate zones.

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dampers in buildings of any height located in Climate Zones 1, 2 and 3. 1.4. Where the design *outdoor air* intake or exhaust capacity does not exceed 300 cfm (141 L/s). Gravity (nonmotorized) dampers for ventilation air intakes shall be protected from direct exposure to wind. 2. Dampers smaller than 24 inches (610 mm) in either dimension shall be permitted to have a leakage of 40 cfm/ft^2 (203.2 L/s · m^2) at 1.0 inch water gauge (w.g.) (249 Pa) when tested in accordance with AMCA 500D.		
C402.4.6 Loading dock weatherseals. Cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.	**5.4.3.3 Loading Dock Weatherseals.** In climate zones 4 through 8, cargo doors and loading dock doors shall be equipped with weather seals to restrict infiltration when vehicles are parked in the doorway.	Standard 90-10 limits where loading dock weatherseals are required based on climate zone.
C402.4.7 Vestibules. All building entrances shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. The installation of one or more revolving doors in the building entrance shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving doors. **Exceptions:** 1. Buildings in Climate Zones 1 and 2. 2. Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use. 3. Doors opening directly from a *sleeping unit* or dwelling unit. 4. Doors that open directly from a space less than 3,000 square feet (298 m^2) in area. 5. Revolving doors. 6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.	**5.4.3.5 Vestibules.** Building entrances that separate conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. Interior and exterior doors shall have a minimum distance between them of not less than 7 ft when in the closed position. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space. The interior and exterior envelope of unconditioned vestibules shall comply with the requirements for a semiheated space. **Exceptions:** a. Building entrances with revolving doors. b. Doors not intended to be used as a building entrance. c. Doors opening directly from a dwelling unit. d. Building entrances in buildings located in climate zone 1 or 2. e. Building entrances in buildings located in climate zone 3 that are less than four stories above grade and less than 10,000 ft2 in area. f. Building entrances in buildings located in climate zone 4, 5, 6, 7, or 8 that are less than 1000 ft^2 in area. g. Doors that open directly from a space that is less than 3000 ft^2 in area and is separate from the building entrance.	Standard 90.1-10 contains a minimum distance requirement that does not appear in the 2012 IECC. The 2009 IBC does contain requirements that are consistent with Standard 90.1-10 for minimum distance requirements. Standard 90.1-10 specifies that the outer portion of the vestibule is subject to envelope requirements where as the 2012 IECC does not provide this type of guidance. Standard 90.1-10 exempts buildings in climate zones 3-8 if certain other criteria are met. IECC only makes an exception in climate zones 1 and 2.

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C402.4.8 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as having an air leakage rate or not more 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa)pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and interior wall or ceiling covering.	**5.8.1.6 Recessed Equipment.** Lighting fixtures; heating, ventilating, air-conditioning equipment, including wall heaters, ducts, and plenums; and other equipment shall not be recessed in such a manner as to affect the insulation thickness unless a. The total combined area affected (including necessary clearances) is less than 1% of the opaque area of the assembly, b. The entire roof, wall, or floor is covered with insulation to the full depth required, or c. The effects of reduced insulation are included in calculations using an area-weighted average method and compressed insulation values obtained from Table A9.4.C. In all cases, air leakage through or around the recessed equipment to the conditioned space shall be limited in accordance with Section 5.4.3.	The 2012 IECC doesn't specify a percentage limitation by which the provisions are not applicable as is the case in Standard 90.1-10 (<1% of opaque area of the assembly).,
SECTION C403 BUILDING MECHANICAL SYSTEMS	**6. HEATING, VENTILATING AND AIR CONDITIONING**	
C403.1 General. Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Section C403.2 (referred to as the mandatory provisions) and either: 1. Section C403.3 (Simple systems); or 2. Section C403.4 (Complex systems).	**6.2.1** Compliance with Section 6 shall be achieved by meeting all requirements for Section 6.1, General; Section 6.7, Submittals; Section 6.8, Minimum Equipment Efficiency; and either: a. Section 6.3, Simplified Approach Option for HVAC Systems; or b. Section 6.4, Mandatory Provisions; and Section 6.5, Prescriptive Path.	There are some scope-related provisions in Standard 90.1-10 that address how to apply the document to additions and alterations of existing buildings. Those were not compared to Chapter 1 of the 2012 IECC but are assumed to lead to the same end using both documents.
C403.2 Provisions applicable to all mechanical systems (Mandatory). Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Sections C403.2.1 through C403.2.11.	**6.4 Mandatory Provisions**	
C403.2.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with the procedures described in ANSI/ASHRAE/ACCA Standard 183. The design loads shall account for the building envelope, lighting, ventilation and occupancy loads based on the project design. Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*.	**6.4.2.1 Load Calculations**. Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with ANSI/ASHRAE/ACCA Standard 183-2007, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings.	The 2012 IECC and Standard 90.1-10 appear to be comparable. The 2012 IECC places restrictions on indoor design temperatures (Chapter 3) which Standard 90.1-10 does not.

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Alternatively, design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in Chapter 3.		
C403.2.2 Equipment and system sizing. The output capacity of heating and cooling equipment and systems shall not exceed the loads calculated in accordance with Section C403.2.1. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options. **Exceptions:** 1. Required standby equipment and systems provided with controls and devices that allow such systems or equipment to operate automatically only when the primary equipment is not operating. 2. Multiple units of the same equipment type with combined capacities exceeding the design load and provided with controls that have the capability to sequence the operation of each unit based on load.	**No Comparable Provision**	While Standard 90.1-10 does not have a comparable section to Section 403.2.2 of the 2012 IECC, it is assumed that the load calculations performed under Standard 90.1-10 will be used to size equipment and systems. Section 6.4.2 of Standard 90.1-10 would support this by saying "for the purpose of sizing systems".
C403.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.2.3(1), C403.2.3(2), C403.2.3(3), C403.2.3(4), C403.2.3(5), C403.2.3(6), C403.2.3(7) and C403.2.3(8) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.2.3(9). The efficiency shall be verified through certification under an *approved* certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.	**6.4.1.1 Minimum Equipment Efficiencies- Listed Equipment-Standard Rating and Operating Conditions.** Equipment shown in Tables 6.8 1A through 6.81K shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements, unless otherwise exempted by footnotes in the table. Equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall have no minimum capacity or other than standard rating condition. Equipment used to provide water heating functions as part of a combination system shall satisfy all stated requirements for the appropriate space heating or cooling category. Tables are as follows: a. Table 6.8.1A—Air Conditioners and Condensing Units b. Table 6.8.1B—Heat Pumps c. Table 6.8.1C—Water-Chilling Packages (see Section 6.4.1.2 for water-cooled centrifugal water-chilling packages that are designed to operate at nonstandard	A comparison of the equipment efficiency tables indicates there are some differences in presentation.

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	conditions) d. Table 6.8.1D—Packaged Terminal and Room Air Conditioners and Heat Pumps e. Table 6.8.1E—Furnaces, Duct Furnaces, and Unit Heaters f. Table 6.8.1F—Boilers g. Table 6.8.1G—Heat Rejection Equipment h. Table 6.8.1.H—Heat Transfer Equipment i. Table 6.8.1I—Variable Refrigerant Flow Air Conditioners j. Table 6.8.1J—Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps k. Table 6.8.1K—Air Conditioners Serving Computer Rooms	
C403.2.3.1 Water-cooled centrifugal chilling packages. Equipment not designed for operation at AHRI Standard 550/590 test conditions of 44°F (7°C) leaving chilled-water temperature and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 l/s · kW) condenser water flow shall have maximum full-load kW/ton and *NPLV* ratings adjusted using Equations 4-3 and 4-4. Adjusted minimum full-load COP ratings = (Full-load COP from Table 6.8.1C of AHRI Standard 550/590) × K_{adi} **(Equation 4-3)** Adjusted minimum NPLV rating = (IPLV from Table 6.8.1C of AHRI Standard 550/590) × K_{adi} **(Equation 4-4)** where: K_{adj} = A × B A = 0.0000015318 × (LIFT)^4 – 0.000202076 × (LIFT)^3 + 0.0101800 × (LIFT)^2 – 0.264958 × LIFT + 3.930196 B = 0.0027 × L_{vg}^{Evap} (°C) + 0.982 LIFT = $L_{vg}^{Cond} - L_{vg}^{Evap}$ L_{vg}^{Cond} = Full-load condenser leaving water temperature (°C) L_{vg}^{Evap} = Full-load leaving evaporator temperature (°C) SI units shall be used in the K_{adj} equation.	**6.4.1.2 Minimum Equipment Efficiencies- Listed Equipment—Nonstandard Conditions.** Equipment not designed for operation at AHRI Standard 550/590 test conditions of 44 °F leaving chilled-fluid temperature and 85 °F entering condenser-fluid temperature with 3 gpm/ton condenser-fluid flow (and, thus, cannot be tested to meet the requirements of Table 6.8.1C) shall have maximum full-load kW/ton and NPLV ratings adjusted using the following equation: Adjusted maximum full-load kW/ton rating= (full-load kW/ton from Table 6.8.1C/Kadj) Adjusted maximum NPLV rating = (IPLV from Table 6.8.1C/Kadj) Kadj = A x B where A= 0.00000014593 x $(LIFT)_4$ – 0.0000346496 x $(LIFT)_3$ + 0.00314196 x $(LIFT)_2$ – 0.147199 x (LIFT) + 3.9302 B= LvgCond – LvgEvap LIFT= Full-load condenser leaving fluid temperature LvgCond= (°F) LvgCond= Full-load evaporator leaving temperature (°F) The adjusted full-load and PNLV values are only applicable for centrifugal chillers meeting all of the following full-load design ranges: • Minimum Evaporator Leaving Temperature: 36°F • Maximum Condenser Leaving Temperature: 115°F • LIFT ε 20°F and δ 80°F	A comparison of both documents indicates that the provisions are identical.

2012 IECC	Standard 90.1-10	Comparative Notes
The adjusted full-load and *NPLV* values shall only be applicable for centrifugal chillers meeting all of the following full-load design ranges: 1. The leaving evaporator fluid temperature is not less than 36°F (2.2°C). 2. The leaving condenser fluid temperature is not greater than 115°F (46.1°C). 3. LIFT is not less than 20°F (11.1 °C) and not greater than 80°F (44.4°C). **Exception:** Centrifugal chillers designed to operate outside of these ranges need not comply with this code.	Manufacturers shall calculate the adjusted maximum kW/ton and NPLV before determining whether to label the chiller per 6.4.1.5. Compliance with 90.0-2007 or -2010 or both shall be labeled on chillers within the scope of the Standard.	
C403.2.3.2 Positive displacement (air- and watercooled) chilling packages. Equipment with a leaving fluid temperature higher than 32°F (0°C), shall meet the requirements of Table C403.2.3(7) when tested or certified with water at standard rating conditions, in accordance with the referenced test procedure.	**6.4.1.2.2 Positive displacement (air- and water- cooled) chilling packages.** Equipment with an evaporator leaving fluid temperature higher than 32°F shall show compliance with Table 6.8.1C when tested or certified with water at standard rating conditions, per the referenced test procedure.	A comparison of both documents indicates that the provisions are identical.
C403.2.4 HVAC system controls. Each heating and cooling system shall be provided with thermostatic controls as specified in Section C403.2.4.1, C403.2.4.2, C403.2.4.3, C403.2.4.4, C403.4.1, C403.4.2, C403.4.3 or C403.4.4.	**6.4.3.1 Zone Thermostatic Controls**	The stringency is equivalent for both.
C403.2.4.1 Thermostatic controls. The supply of heating and cooling energy to each *zone* shall be controlled by individual thermostatic controls capable of responding to temperature within the *zone*. Where humidification or dehumidification or both is provided, at least one humidity control device shall be provided for each humidity control system. **Exception:** Independent perimeter systems that are designed to offset only building envelope heat losses or gains or both serving one or more perimeter *zone*s also served by an interior system provided: 1. The perimeter system includes at least one thermostatic control *zone* for each building exposure having exterior walls facing only one orientation (within +/-45 degrees) (0.8 rad) for more than 50 contiguous feet (15 240 mm); and 2. The perimeter system heating and cooling supply is	**6.4.3.1.1 General.** The supply of heating and cooling energy to each zone shall be individually controlled by thermostatic controls responding to temperature within the zone. For the purposes of Section 6.4.3.1, a dwelling unit shall be permitted to be considered a single zone. **Exceptions**: Independent perimeter systems that are designed to offset only building envelope loads shall be permitted to serve one or more zones also served by an interior system provided: a. The perimeter system includes at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation for 50 contiguous feet or more, and b. The perimeter system heating and cooling supply is controlled by a thermostatic control(s) located within the zone(s) served by the system. Exterior walls are considered to have different orientations if	Both are comparable.

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controlled by a thermostats located within the *zones* served by the system.	the directions they face differ by more than 45 degrees.	
C403.2.4.1.1 Heat pump supplementary heat. Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation where the heat pump can meet the heating load.	**6.4.3.5 Heat Pump Auxiliary Heat Control**. Heat pumps equipped with internal electric resistance heaters shall have controls that prevent supplemental heater operation when the heating load can be met by the heat pump alone during both steady-state operation and setback recovery. Supplemental heater operation is permitted during outdoor coil defrost cycles. **Exception:** Heat pumps whose minimum efficiency is regulated by NAECA and whose HSPF rating both meets the requirements shown in Table 6.8.1B and includes all usage of internal electric resistance heating.	Standard 90.1-10 refers to conditions of steady-state operation and setback recovery while the 2009 IECC does not, so Standard 90.1-10 could be considered slightly more stringent here. Standard 90.1-10 contains the heat pump exception that is not in 2012 IECC for equipment that is regulated by NAECA
C403.2.4.2 Set point overlap restriction. Where used to control both heating and cooling, *zone* thermostatic controls shall provide a temperature range or deadband of at least 5°F (2.8°C) within which the supply of heating and cooling energy to the *zone* is capable of being shut off or reduced to a minimum. **Exception:** Thermostats requiring manual changeover between heating and cooling modes.	**6.4.3.1.2 Dead Band.** Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum. **Exceptions:** a. Thermostats that require manual changeover between heating and cooling modes. b. Special occupancy or special applications (such as retirement homes, process applications, museums, some areas of hospitals) and are approved by the authority having jurisdiction. **6.4.3.2 Setpoint Overlap Restriction**. Where heating and cooling to a zone are controlled by separate zone thermostatic controls located within the zone, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided to prevent the heating setpoint from exceeding the cooling setpoint minus any applicable proportional band.	Standard 90.1-10 contains an exception for special occupancy/applications that is not in the 2012 IECC. The 2012 IECC does not contain provisions to address separate heating and cooling thermostats as does Standard 90.1-10. As such, where those conditions are found in a building, it is more likely a building constructed to Standard 90.1-10 would have the capability to save energy in operations while the same building constructed to the 2012 IECC would not.
C403.2.4.3 Off-hour controls. Each *zone* shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system. **Exceptions:** 1. *Zones* that will be operated continuously.	**6.4.3.3 Off-Hour Controls.** HVAC systems shall have the off-hour controls required by Section 6.4.3.3.1 through 6.4.3.3.4. **Exception:** a. HVAC systems intended to operate continuously. b. HVAC systems having a design heating capacity and	Standard 90.1-10 exempts spaces with a design load of 15,000 Btu/h for cooling systems only. The 2012 IECC places a lower limit on the exception and addresses both heating and cooling.

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2. *Zones* with a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a readily accessible manual shutoff switch.	cooling capacity less than 15,000 Btu/h that are equipped with readily accessible manual ON/OFF controls.	
C403.2.4.3.1 Thermostatic setback capabilities. Thermostatic setback controls shall have the capability to set back or temporarily operate the system to maintain *zone* temperatures down to 55°F (13°C) or up to 85°F (29°C).	**6.4.3.3.2 Setback Controls.** Heating systems located in climate zones 2-8 shall be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures above a heating setpoint adjustable down to 55°F or lower. Cooling systems located in climate zones 1b, 2b, and 3b shall be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures below a cooling setpoint adjustable up to 90°F or higher to prevent high space humidity levels. **Exception:** Radiant floor and ceiling heating systems.	The provisions of Standard 90.1-10 appear to be more stringent than those of the 2012 IECC and, as such, systems constructed to the former would be more likely to be operated to save additional energy. High temperature limit differs between Standard 90.1-10 and the 2012 IECC. The 2012 IECC has a limit of 85 °F where as Standard 90.1-10 places the limit at, 90°F or higher to prevent humidity. ASHRAE exempts radiant systems from this requirement.
C403.2.4.3.2 Automatic setback and shutdown capabilities. Automatic time clock or programmable controls shall be capable of starting and stopping the system for seven different daily schedules per week and retaining their programming and time setting during a loss of power for at least 10 hours. Additionally, the controls shall have a manual override that allows temporary operation of the system for up to 2 hours; a manually operated timer capable of being adjusted to operate the system for up to 2 hours; or an occupancy sensor.	**6.4.3.3.1 Automatic Shutdown.** HVAC systems shall be equipped with at least one of the following: a. Controls that can start and stop the system under different time schedules for seven different day-types per week, are capable of retaining programming and time setting during loss of power for a period of at least ten hours, and include an accessible manual override, or equivalent function, that allows temporary operation of the system for up to two hours. b. An occupant sensor that is capable of shutting the system off when no occupant is sensed for a period of up to 30 minutes. c. A manually operated timer capable of being adjusted to operate the system for up to two hours. d. An interlock to a security system that shuts the system off when the security system is activated. **Exception:** Residential occupancies may use controls that can start and stop the system under two different time schedules per week.	The provisions of Standard 90.1-10 appear to be more stringent than those of the 2012 IECC and, as such, systems constructed to the former would be more likely to be operated to save additional energy.
C403.2.4.3.3 Automatic start capabilities. Automatic start controls shall be provided for each HVAC system. The controls shall be capable of automatically adjusting the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to	**6.4.3.3.3 Optimum Start Controls.** Individual heating and cooling air distribution systems with a total design supply air capacity exceeding 10,000 cfm, served by one or more supply fans, shall have optimum start controls. The control algorithm shall, as a minimum, be a function of the difference between space temperature and	Both require automatic start capabilities. The systems are described differently but appear to serve the same purpose. Standard 90.1-10 includes a minimum size below which these controls are not required which makes the 2012 IECC more stringent for smaller systems.

2012 IECC	Standard 90.1-10	Comparative Notes
scheduled occupancy.	occupied setpoint and the amount of time prior to scheduled occupancy.	
	6.4.3.3.4 Zone Isolation. HVAC systems serving zones that are intended to operate or be occupied nonsimultaneously shall be divided into isolation areas. Zones may be grouped into a single isolation area provided it does not exceed 25,000 ft2 of conditioned floor area nor include more than one floor. Each isolation area shall be equipped with isolation devices capable of automatically shutting off the supply of conditioned air and outdoor air to and exhaust air from the area. Each isolation area shall be controlled independently by a device meeting the requirements of Section 6.4.3.3.1, Automatic Shutdown. For central systems and plants, controls and devices shall be provided to allow stable system and equipment operation for any length of time while serving only the smallest isolation area served by the system or plant. **Exceptions:** Isolation devices and controls are not required for the following: a. Exhaust air and outdoor air connections to isolation zones when the fan system to which they connect is 5000 cfm and smaller. b. Exhaust airflow from a single isolation zone of less than 10% of the design airflow of the exhaust system to which it connects. c. Zones intended to operate continuously or intended to be inoperative only when all other zones are inoperative.	The provisions of Standard 90.1-10, in addressing the subject controls, would appear to be more stringent than those of the 2012 IECC and, as such, systems constructed to the former would be more likely to be operated to save additional energy.
C403.2.4.4 Shutoff damper controls. Both outdoor air supply and exhaust ducts shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use. **Exceptions:** 1. Gravity dampers shall be permitted in buildings less than three stories in height. 2. Gravity dampers shall be permitted for buildings of any height located in Climate Zones 1, 2 and 3. 3. Gravity dampers shall be permitted for outside air intake or exhaust airflows of 300 cfm (0.14 m^3/s) or less.	**6.4.3.4.2 Shutoff Damper Controls.** All outdoor air intake and exhaust systems shall be equipped with motorized dampers that will automatically shut the systems or spaces served are not in use. Ventilation outdoor air and exhaust/relief dampers shall be capable of automatically shutting off during preoccupancy building warm-up, cool down, and setback, except when ventilation reduces energy costs or when ventilation must be supplied to meet code requirements. **Exceptions:** a. Backdraft gravity (nonmotorized) dampers are acceptable for exhaust and relief in buildings less than three stories in height and for ventilation air intakes and exhaust and relief dampers in buildings of any height	The provisions of the 2012 IECC and Standard 90.1-10 address automatic shutoff of ventilation outdoor air dampers during some conditions where the building could be occupied. The 2012 IECC allows the use of gravity dampers in any building less than 3 stories which would make Standard 90.1-10 more stringent in colder climate zones.

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	located in climate zones 1, 2, and 3. Backdraft dampers for ventilation air intakes must be protected from direct exposure to wind. b. Backdraft gravity (nonmotorized) dampers are acceptable in systems with a design outdoor air intake or exhaust capacity of 300 cfm or less. c. Dampers are not required in ventilation or exhaust systems serving unconditioned spaces. d. Dampers are not required in exhaust systems serving Type 1 kitchen exhaust hoods.	
C403.2.4.5 Snow melt system controls. Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F (10°C) and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F (4°C) so that the potential for snow or ice accumulation is negligible.	**6.4.3.8 Freeze Protection and Snow/Ice Melting Systems.** Freeze protection systems, such as heating tracing of outdoor piping and heat exchangers, including self-regulating heat tracing, shall include automatic controls capable of shutting off the systems when outdoor air temperatures are above 40 °F or when the conditions of the protection fluid will prevent freezing. Snow- and ice- melting systems shall include automatic controls capable of shutting off the systems when the pavement temperature is above 50°F and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F so that the potential for snow or ice accumulation is negligible.	The provisions of both documents are comparable.
C403.2.5 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the *International Mechanical Code*. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the *International Mechanical Code.*	**No Comparable Provision**	There is a reference to ASHRAE Standard 62.1 (minimum ventilation requirements) in Standard 90.1-10, but it is only a reference with no requirement that one actually use or comply with the standard. Because the standard is likely applied with other codes, such as the International Mechanical Code, the absence of ventilation provisions in Standard 90.1-10 would not be considered significant.
C403.2.5.1 Demand controlled ventilation. Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet (50 m2) and with an average occupant load of 25 people per 1000 square feet (93 m2) of floor area (as established in Table 403.3 of the *International Mechanical Code*) and served by systems with one or more of the following: 1. An air-side economizer; 2. Automatic modulating control of the outdoor air damper; or 3. A design outdoor airflow greater than 3,000 cfm (1400 L/s).	**6.4.3.9 Ventilation Controls for High-Occupancy Areas.** Demand control ventilation (DCV) is required for spaces larger than 500 ft2 and with a design occupancy for ventilation of greater than 40 people per 1000 ft2 of floor area and served by systems with one or more of the following: a. An air-side economizer b. Automatic modulating control of the outdoor air damper, c. Or a design outdoor airflow greater than 3000 cfm. **Exceptions:** a. Systems with the exhaust air energy recovery complying with Section 6.5.6.1	The DCV requirement is triggered with a smaller occupant load in 2012 IECC making this requirement more stringent than Standard 90.1-10.

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Exception: Demand control ventilation is not required for systems and spaces as follows: 1. Systems with energy recovery complying with Section C403.2.6. 2. Multiple-*zone* systems without direct digital control of individual *zones* communicating with a central control panel. 3. System with a design outdoor airflow less than 1,200 cfm (600 L/s). 4. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (600 L/s). 5. Ventilation provided for process loads only.	b. Multiple-zone systems without DDC of individual zones communicating with a central control panel. c. Systems with a design outdoor airflow less than 1200 cfm. d. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1200 cfm.	
C403.2.6 Energy recovery ventilation systems. Where the supply airflow rate of a fan system exceeds the values specified in Table C403.2.6, the system shall include an energy recovery system. The energy recovery system shall have the capability to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls which permit operation of the economizer as required by Section C403.4 **Exception:** An energy recovery ventilation system shall not be required in any of the following conditions: 1. Where energy recovery systems are prohibited by the *International Mechanical Code*. 2. Laboratory fume hood systems that include at least one of the following features: 2.1. Variable-air-volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values. 2.2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (1.1°C) above room setpoint, cooled to no cooler than 3°F (1.7°C) below room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control. 3. Systems serving spaces that are heated to less than	**6.5.6.1 Exhaust Air Energy Recovery.** Each fan system shall have an energy recovery system when the system's supply air flow rate exceeds the value listed in Table 6.5.6.1 based on the climate zone and percentage of outdoor air flow rate at design conditions. Energy recovery systems required by this section shall have at least 50% energy recovery effectiveness. Fifty percent energy recovery effectiveness shall mean a change in the enthalpy of the outdoor air supply equal to 50% of the difference between the outdoor air and return air enthalpies at design conditions. Provision shall be made to bypass or control the energy recovery system to permit air economizer operation as required by 6.5.1.1. **Exception:** a. Laboratory systems meeting 6.5.7.2 b. Systems serving spaces that are not cooled and that are heated to less than 60°F. c. Systems exhausting toxic, flammable, paint, or corrosive fumes or dust. d. Commercial kitchen hoods used for collecting and removing grease vapors and smoke. e. Where more than 60% of the outdoor air heating energy is provided from site-recovered or site solar energy. f. Heating energy recovery in climate zones 1 and 2. g. Cooling energy recovery in climate zones 3c, 4c, 5b, 5c, 6b, 7, and 8. h. Where the largest source of air exhausted at a single location at the building exterior is less than 75% of the design outdoor air flow rate.	The text is essentially the same in both documents.

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60°F (15.5°C) and are not cooled. 4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy. 5. Heating energy recovery in Climate Zones 1 and 2. 6. Cooling energy recovery in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8. 7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil. 8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design *outdoor air* flow rate. 9. Systems expected to operate less than 20 hours per week at the *outdoor air* percentage covered by Table C403.2.6	i. Systems requiring dehumidification that employ energy recovery in series with the cooling coil. j. Systems expected to operate less than 20 hrs per week at the outdoor air percentage covered by Table 6.5.6.1	
C403.2.7 Duct and plenum insulation and sealing. All supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation where located in unconditioned spaces and a minimum of R-8 insulation where located outside the building. Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum of R-8 insulation. **Exceptions:** 1. Where located within equipment. 2. Where the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (8°C). All ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with Section 603.9 of the *International Mechanical Code*.	**6.4.4.1.2 Duct and Plenum Insulation.** All supply and return ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated in accordance with Tables 6.8.2A and 6.8.2B **Exceptions:** a. Factory-installed plenums, casings, or ductwork furnished as a part of HVAC equipment tested and rated in accordance with Section 6.4.1 b. Ducts or plenums located in heated spaces, semiheated spaces, or cooled spaces. c. For runouts less than 10 ft in length to air terminals or air outlets, the rated R-value of insulation need not exceed R-3.5. d. Backs of air outlets and outlet plenums exposed to unconditioned or indirectly conditioned spaces with face areas exceeding 5 ft2 need not exceed R-2; those 5 ft2 or smaller need not be insulted.	Standard 90.1-10 has insulating requirements are dependent on climate zone, if ducts are used for heating/cooling only and if the duct is supply or return. Standard 90.1-10 has more exceptions for lower duct R-values dependent on where they are located in the building. The 2012 IECC appears to be more stringent.
C403.2.7.1 Duct construction. Ductwork shall be constructed and erected in accordance with the *International Mechanical Code*.	**Section 6.4.4** is entitled HVAC construction and insulation but in reality covers leakage and insulation and not the specific construction of the ducts.	It is not possible to fully compare the documents, in that the 2012 IECC is part of a coordinated set of codes and has duct construction provisions in the International Mechanical Code to refer to. ASHRAE Standard 90.1-10 does not contain provisions for duct construction per se, but one building to Standard 90.1-10 would likely be responsible for meeting applicable state or local mechanical codes that address duct construction.

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C403.2.7.1.1 Low-pressure duct systems. All longitudinal and transverse joints, seams and connections of supply and return ducts operating at a static pressure less than or equal to 2 inches water gauge (w.g.) (500 Pa) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus embedded- fabric systems or tapes installed in accordance with the manufacturer's installation instructions. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the *International Mechanical Code*. **Exception:** Continuously welded and locking type longitudinal joints and seams on ducts operating at static pressures less than 2 inches water gauge (w.g.) (500 Pa) pressure classification.	**Section 6.4.4.2** has provisions that govern duct sealing. It provides three classes of sealing specifications and then applies them based on duct location, operating pressure and if they are supply, exhaust or return air ducts.	A comparison of the provisions in the 2012 IECC and Standard 90.1-10 appear to indicate that the former is equal to, or more rigorous than, the latter.
C403.2.7.1.2 Medium-pressure duct systems. All ducts and plenums designed to operate at a static pressure greater than 2 inches water gauge (w.g.) (500 Pa) but less than 3 inches w.g. (750 Pa) shall be insulated and sealed in accordance with Section C403.2.7. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the *International Mechanical Code*.		
C403.2.7.1.3 High-pressure duct systems. Ducts designed to operate at static pressures in excess of 3 inches water gauge (w.g.) (750 Pa) shall be insulated and sealed in accordance with Section C403.2.7. In addition, ducts and plenums shall be leak-tested in accordance with the SMACNA *HVAC Air Duct Leakage Test Manual* with the rate of air leakage (*CL*) less than or equal to 6.0 as determined in accordance with Equation 4-5. $CL = F/P^{0.65}$ **(Equation 4-5)** where: F = The measured leakage rate in cfm per 100 square feet of duct surface. P = The static pressure of the test. Documentation shall be furnished by the designer demonstrating that representative sections totaling at	**6.4.4.2.2 Duct Leakage Tests**. Ductwork that is designed to operate at static pressures in excess of 3 in. w.c. and all ductwork located outdoors shall be leak-tested according to industry-accepted test procedures (see Informative Appendix E). Representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested. All sections shall be slected by the building owner or the designated representative of the building owner. Positive pressure leakage testing is acceptable for negative pressure ductwork. The maximum permitted duct leakage shall be $L_{MAX}=C_L P_{0.65}$ Where L_{MAX} = maximum permitted leakage cfm/100 ft2 duct	Standard 90.1-10 is more stringent than the 2012 IECC in that it requires high pressure duct systems to meet a CL of 4 versus 6 in the 2012 IECC.

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least 25 percent of the duct area have been tested and that all tested sections meet the requirements of this section.	surface area; C_L = 4, duct leakage class, cfm/100 ft2 duct surface area at 1 in. w.c.; and P = test pressure, which shall be equal to the design duct pressure class rating, in. w.c.	
C403.2.8 Piping insulation. All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table C403.2.8. **Exceptions:** 1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code. 2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and 840, respectively. 3. Piping that conveys fluids that have a design operating temperature range between 60°F (15°C) and 105°F (41°C). 4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power. 5. Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter. 6. Direct buried piping that conveys fluids at or below 60°F (15°C)	**6.4.4.1.3 Piping Insulation.** Piping shall be thermally insulated in accordance with Tables 6.8.3A and 6.8.3B. **Exceptions:** a. Factory-installed piping within HVAC equipment tested and rated in accordance with Section 6.4.1 b. Piping that conveys fluids having a design operating temperature range between 60°F and 105°F, inclusive. c. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electricity (such as roof and condensate drains, domestic cold water supply, natural gas piping), d. Where heat gain or heat loss will not increase energy usage (such as liquid refrigerant piping). e. In piping 1 in. or less, insulation is not required for strainers, control valves, and balancing valves.	The text is essentially the same in both documents.
C403.2.8.1 Protection of piping insulation. Piping insulation exposed to weather shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesives tape shall not be permitted.	**No Comparable Provision**	No comparable provision in Standard 90.1-10
C403.2.9 Mechanical systems commissioning and completion requirements. Mechanical systems shall be commissioned and completed in accordance with Section C408.2.	**6.7.2.4 System Commissioning.** HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 ft^2 conditioned area, except warehouses and semiheated spaces, detailed instructions for	The 2012 IECC requires system commissioning based on the total building HVAC capacity for heating and cooling systems regardless of floor area. Standard 90.1-10 bases commissioning requirements on floor area. It is unclear is buildings <50,000 ft^2 are required

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	commissioning HVAC systems (see Informative Appendix E) shall be provided by the designer in plans and specifications.	to be commissioned under Standard 90.1-10 so it is difficult to determine which is more stringent.
C403.2.10 Air system design and control. Each HVAC system having a total fan system motor nameplate horsepower (hp) exceeding 5 horsepower (hp) (3.7 kW) shall meet the provisions of Sections C403.2.10.1 through C403.2.10.2.	**6.5.3 Air System Design and Control.** Each HVAC system having a total fan system motor nameplate hp exceeding 5 hp shall meet the provisions of Section 6.5.3.1 through 6.5.3.4.	The requirements in Standard 90.1-10 and the 2012 IECC are identical.
C403.2.10.1 Allowable fan floor horsepower. Each HVAC system at fan system design conditions shall not exceed the allowable *fan system motor nameplate hp* (Option 1) or *fan system bhp* (Option 2) as shown in Table C403.2.10.1(1). This includes supply fans, return/relief fans, and fan-powered terminal units associated with systems providing heating or cooling capability. Single *zone* variable-air-volume systems shall comply with the constant volume fan power limitation. **Exception:** The following fan systems are exempt from allowable fan floor horsepower requirement. 1. Hospital, vivarium and laboratory systems that utilize flow control devices on exhaust and/or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall be permitted to use variable volume fan power limitation. 2. Individual exhaust fans with motor nameplate horsepower of 1 hp or less.	**6.5.3.1.1** Each HVAC system at fan system design conditions shall not exceed the allowable fan system motor nameplate hp (Option 1) or fan system bhp (Option 2) as shown in Table 6.5.3.1.1A. this includes supply fans, return/relief fans, exhaust fans, and fan-powered terminal units associated with systems providing heating or cooling capability. Single zone variable-air-volume systems shall comply with the constant volume fan power limitation. **Exceptions:** a. Hospital, vivarium, and laboratory systems that utilize flow control devices on exhaust and/or return to maintain space pressure relationships necessary for occupant health and safety or environmental control may use variable-volume fan power limitation. b. Individual exhaust fans with motor nameplate horsepower of 1 hp or less.	The requirements in Standard 90.1-10 and the 2012 IECC are identical.
C403.2.10.2 Motor nameplate horsepower. For each fan, the selected fan motor shall be no larger than the first available motor size greater than the brake horsepower (bhp). The fan brake horsepower (bhp) shall be indicated on the design documents to allow for compliance verification by the *code official*. **Exceptions:** 1. For fans less than 6 bhp (4413 W), where the first available motor larger than the brake horsepower has a nameplate rating within 50 percent of the bhp, selection of the next larger nameplate motor size is allowed. 2. For fans 6 bhp (4413 W) and larger, where the first	**6.5.3.1.2 Motor Nameplate Horsepower.** For each fan, the selected fan motor shall be no larger than the first available motor size greater than the bhp. The fan bhp must be indicated on the design documents to allow for compliance verification by the code official. **Exceptions:** a. For fans less than 6 bhp, where the first available motor larger than the bhp has a nameplate rating within 50% of the bhp, the next larger nameplate motor size may be selected. b. For fans 6 bhp and larger, where the first available motor larger than the bhp has a nameplate rating within 30% of the bhp, the next larger nameplate motor size may be	These provisions appear to be identical.

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available motor larger than the bhp has a nameplate rating within 30 percent of the bhp, selection of the next larger nameplate motor size is allowed.	selected.	
C403.2.11 Heating outside a building. Systems installed to provide heat outside a building shall be radiant systems. Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically deenergized when no occupants are present.	**6.5.8.1 Heating Unenclosed Spaces.** Radiant heating shall be used when heating unenclosed spaces. Exception: Loading docks equipped with air curtains.	Based on the Standard 90.1-10 definition of "unenclosed space" (which is not an enclosed space – a volume substantially surrounded by solid surfaces such as walls, floors, roofs, and openable devices such as doors and operable windows) these provisions seem to be addressing the same issue. The 2012 IECC adds the requirement of occupancy sensing or timers for shutoff.
C403.3 Simple HVAC systems and equipment (Prescriptive). This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables C403.2.3(1) through C403.2.3(8), each serving one *zone* and controlled by a single thermostat in the *zone* served. It also applies to two pipe heating systems serving one or more *zones*, where no cooling system is installed.	**Section 6.3 has provisions for simple systems that to some degree cover items in Chapter 4 [CE].**	The format of both documents makes it difficult to do a side-by-side comparison.
C403.3.1 Economizers. Each cooling system that has a fan shall include either an air or water economizer meeting the requirements of Sections C403.3.1.1 through C403.3.1.1.4. **Exception:** Economizers are not required for the systems listed below. 1. Individual fan-cooling units with a supply capacity less than the minimum listed in Table C403.3.1(1). 2. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7 °C) dew-point temperature to satisfy process needs. 3. Systems that serve *residential* spaces where the system capacity is less than five times the requirement listed in Table C403.3.1(1). 4. Systems expected to operate less than 20 hours per week. 5. Where the use of *outdoor air* for cooling will affect supermarket open refrigerated casework systems. 6. Where the cooling *efficiency* meets or exceeds the *efficiency* requirements in Table C403.3.1(2).	**6.5.1 Economizers.** Each cooling system that has a fan shall include either an air or water economizer meeting the requirements of Section 6.5.1.1 through 6.5.1.4. **Exceptions**: Economizers are not required for the systems listed below. a. Individual fan-cooling units with a supply capacity less than the minimum listed in Table 6.5.1A for comfort cooling applications and Table 6.5.1B for computer room applications. b. Systems that include nonparticulate air treatment as required by Section 6.2.1 in Standard 62.1. c. In hospitals and ambulatory surgery centers, where more than 75% of the air designed to be supplied by the system is to spaces that are required to be humidified above 35°F dew-point temperature to comply with applicable codes or accreditation standards. In all other buildings, where more than 25% of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F dew-point temperature to satisfy process needs. This exception does not apply to computer rooms. d. Systems that include a condenser heat recovery system with a minimum capacity as defined in 6.5.6.2.2a or	The 2012 IECC requires economizers for systems greater than or equal to 33,000 Btu/h which is more stringent than Standard 90.1-10. The 2012 IECC provides equipment efficiency trade-offs for systems located in 3 climate zones where as Standard 90.1-10 provides trade-offs for all climate zones where economizers are required. All other requirements are the same. The 2012 IECC looks to be more stringent.

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	6.5.6.2.2b. e. Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table 6.5.1A. f. Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60°F. g. Systems expected to operate less than 20 hours per week. h. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems. i. For comfort cooling where the cooling efficiency meets or exceeds the efficiency improvement requirements in Table 6.3.2. j. Systems primarily serving computer rooms where: a. The total design cooling load of all computer rooms in the building is less than 3,000,000 Btu/h and the building in which they are located is not served by a centralized chilled water plant, or b. the room total design cooling load is less than 600,000 Btu/h and the building in which they are located is served by a centralized chilled water plant, or c. the local water authority does not allow cooling towers, or d. less than 600,000 Btu/h of computer room cooling equipment capacity is being added to an existing building. k. Dedicated systems for computer rooms where a minimum of 75% of the design load serves: a. Those spaces classified as an essential facility b. Those spaces having a mechanical cooling design of Tier IV as defined by ANSI/TIA-942 c. Those spaces classified under NFPA 70 Article 708 – Critical Operations Power Systems (COPS) d. Those spaces where core clearing and settlement services are performed such that their failure to settle pending financial transactions could present systemic risk as	

2012 IECC	Standard 90.1-10	Comparative Notes
	described in "The Interagency Paper on Sound Practices to Strengthen the Resilience of the US Financial System, April 7, 2003"	
C403.3.1.1 Air economizers. Air economizers shall comply with Sections C403.3.1.1.1 through C403.3.1.1.4.	**6.5.1.1 Air Economizers**	
C403.3.1.1.1 Design capacity. Air economizer systems shall be capable of modulating *outdoor air* and return air dampers to provide up to 100 percent of the design supply air quantity as *outdoor air* for cooling.	**6.5.1.1.1 Design Capacity.** Air economizer systems shall be capable of modulating outdoor air and return air dampers to provide up to 100% of the design supply air quantity as outdoor air for cooling.	These provisions appear to be identical.
C403.3.1.1.2 Control signal. Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed air temperature. **Exception:** The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single *zone* systems).	**6.5.1.1.2. Control Signal.** Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed air temperature. **Exception:** The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-zone systems).	These provisions appear to be identical.
C403.3.1.1.3 High-limit shutoff. Air economizers shall be capable of automatically reducing *outdoor air* intake to the design minimum *outdoor air* quantity when *outdoor air* intake will no longer reduce cooling energy usage. High-limit shutoff control types for specific climates shall be chosen from Table C403.3.1.1.3(1). High-limit shutoff control settings for these control types shall be those specified in Table C403.3.1.1.3(2).	**6.5.1.1.3. High-Limit Shutoff.** All air economizers shall be capable of automatically reducing outdoor air intake to the design minimum outdoor air quantity when outdoor air intake will no longer reduce cooling energy usage. High-limit shutoff control types for specific climates shall be chosen from Table 6.5.1.1.3A. High-limit shutoff control settings these control types shall be those listed in Table 6.5.1.1.3B.	These provisions appear to be identical.
C403.3.1.1.4 Relief of excess outdoor air. Systems shall be capable of relieving excess *outdoor air* during air economizer operation to prevent over-pressurizing the building. The relief air outlet shall be located to avoid recirculation into the building.	**6.5.1.1.5 Relief of Excess Outdoor Air.** Systems shall provide a means to relieve excess outdoor air during air economizer operation to prevent overpressurizing the building. The relief air outlet shall be located to avoid recirculation into the building.	These provisions appear to be identical.
C403.4 Complex HVAC systems and equipment. (Prescriptive). This section applies to buildings served by HVAC equipment and systems not covered in Section C403.3.		
C403.4.1 Economizers. Economizers shall comply with Sections C403.4.1.1 through C403.4.1.4.		
C403.4.1.1 Design capacity. Water economizer systems shall be capable of cooling supply air by	**6.5.1.2.1 Design Capacity**. Water economizer systems shall be capable of cooling supply air by indirect evaporation and	The base economizer requirement is identical between Standard 90.1-10 and the 2012 IECC. Standard 90.1-

2012 IECC	Standard 90.1-10	Comparative Notes
indirect evaporation and providing up to 100 percent of the expected system cooling load at *outdoor air* temperatures of 50°F dry bulb (10°C dry bulb)/45°F wet bulb (7.2°C wet bulb) and below. **Exception:** Systems in which a water economizer is used and where dehumidification requirements cannot be met using outdoor air temperatures of 50°F dry bulb (10°C dry bulb)/45°F wet bulb (7.2°C wet bulb) shall satisfy 100 percent of the expected system cooling load at 45°F dry bulb (7.2°C dry bulb)/ 40°F wet bulb (4.5°C wet bulb).	providing up to 100% of the expected system cooling load at outdoor air temperatures of 50°f dry bulb/45°F wet bulb and below. **Exceptions**: a. Systems primarily serving computer rooms in which 100% of the expected system cooling load at 40° dry bulb/ 35°F wet bulb is met with evaporative water economizers. b. Systems primarily serving computer rooms with dry cooler water economizers which satisfy 100% of the expected system cooling load at 35°F dry bulb. c. Systems where dehumidification requirements cannot be met using outdoor air temperatures of 50° dry bulb/45°F wet bulb and where 100% of the expected system cooling load at 45°F dry bulb/40°F wet bulb is met with evaporative water economizers.	10 includes exceptions for computer rooms and both have exceptions for dehumidification.
C403.4.1.2 Maximum pressure drop. Precooling coils and water-to-water heat exchangers used as part of a water economizer system shall either have a waterside pressure drop of less than 15 feet (4572 mm) of water or a secondary loop shall be created so that the coil or heat exchanger pressure drop is not seen by the circulating pumps when the system is in the normal cooling (noneconomizer) mode.	**6.5.1.2.2 Maximum Pressure Drop**. Precooling coils and water-to-water exchangers used as part of a water economizer system shall either have a water-side pressure drop of less than 15 ft of water or a secondary loop shall be created so that the coil or heat exchanger pressure drop is not seen by the circulating pumps when the system is in the normal cooling (noneconomizer) mode.	These provisions appear to be identical.
C403.4.1.3 Integrated economizer control. Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even where additional mechanical cooling is required to meet the remainder of the cooling load. **Exceptions:** 1. Direct expansion systems that include controls that reduce the quantity of *outdoor air* required to prevent coil frosting at the lowest step of compressor unloading, provided this lowest step is no greater than 25 percent of the total system capacity. 2. Individual direct expansion units that have a rated cooling capacity less than 54,000 Btu/h (15 827 W) and use nonintegrated economizer controls that preclude simultaneous operation of the	**6.5.1.3 Integrated Economizer Control.** Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.	These provisions appear to be identical for systems rated at 54,000 Btu/h and greater. The 2012 IECC allows systems less than 54,000 Btu/h to have non-integrated economizers.

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economizer and mechanical cooling.		
C403.4.1.4 Economizer heating system impact. HVAC system design and economizer controls shall be such that economizer operation does not increase the building heating energy use during normal operation. **Exception:** Economizers on VAV systems that cause *zone* level heating to increase due to a reduction in supply air temperature.	**6.5.1.4 Economizer Heating System Impact.** HVAC system design and economizer controls shall be such that economizer operation does not increase the building heating energy use during normal operation. **Exception:** Economizer on VAV systems that cause zone level heating to increase due to a reduction in supply air temperatures.	These provisions appear to be identical.
C403.4.2 Variable air volume (VAV) fan control. Individual VAV fans with motors of 7.5 horsepower (5.6 kW) or greater shall be: 1. Driven by a mechanical or electrical variable speed drive; 2. Driven by a vane-axial fan with variable-pitch blades; or 3. The fan shall have controls or devices that will result in fan motor demand of no more than 30 percent of their design wattage at 50 percent of design airflow when static pressure set point equals one-third of the total design static pressure, based on manufacturer's certified fan data.	**6.5.3.2.1 Part-Load Fan Power Limitation.** Individual VAV fans with motors 10 hp and larger shall meet one of the following: a. The fan shall be driven by a mechanical or electrical variable-speed drive. b. The fan shall be a vane-axial fan with variable-pitch blades. c. The fan shall have other controls and devices that will result in fan motor demand of no more than 30% of design wattage at 50% of design air volume when static pressure setpoint equals one-third of the total design static pressure, based on manufactures' certified fan data.	The 2012 IECC places requirements for fan motors of 7.5 horsepower and greater and Standard 90.1-10 sets the fan motor size at 10 horsepower. The 2012 IECC is more stringent.
C403.4.2.1 Static pressure sensor location. Static pressure sensors used to control VAV fans shall be placed in a position such that the controller setpoint is no greater than one-third the total design fan static pressure, except for systems with *zone* reset control complying with Section C403.4.2.2. For sensors installed down-stream of major duct splits, at least one sensor shall be located on each major branch to ensure that static pressure can be maintained in each branch.	**6.5.3.2.2 Static Pressure Sensor Location.** Static pressure sensors used to control VAV fans shall be placed in a position such that the controller setpoint is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with Section 6.5.3.2.3. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch to ensure that static pressure can be maintained in each.	These provisions appear to be identical.
C403.4.2.2 Set points for direct digital control. For systems with direct digital control of individual *zone* boxes reporting to the central control panel, the static pressure set point shall be reset based on the *zone* requiring the most pressure, i.e., the set point is reset lower until one *zone* damper is nearly wide open.	**6.5.3.2.3 Setpoint Reset**. For systems with DDC of individual zone boxes reporting to the central control panel, static pressure setpoint shall be reset based on the zone requiring the most pressure; i.e., the setpoint is reset lower until one zone damper is nearly wide open.	These provisions appear to be identical.

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C403.4.3 Hydronic systems controls. The heating of fluids that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with Sections C403.4.3.1 through C403.4.3.3. Hydronic heating systems comprised of multiple-packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers. Hydronic heating systems comprised of a single boiler and greater than 500,000 Btu/h (146 550 W) input design capacity shall include either a multistaged or modulating burner.	**6.5.2.2. Hydronic System Controls.** The heating of fluids in hydronic systems that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with Sections 6.5.2.2.1 through 6.5.2.2.3.	A review of both documents finds them to be about the same.
C403.4.3.1 Three-pipe system. Hydronic systems that use a common return system for both hot water and chilled water are prohibited.	**6.5.2.2.1 Three-Pipe System**. Hydronic systems that use a common return system for both hot water and chilled water shall not be used.	A review of both documents finds them to be about the same.
C403.4.3.2 Two-pipe changeover system. Systems that use a common distribution system to supply both heated and chilled water shall be designed to allow a dead band between changeover from one mode to the other of at least 15°F (8.3°C) outside air temperatures; be designed to and provided with controls that will allow operation in one mode for at least 4 hours before changing over to the other mode; and be provided with controls that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F (16.7°C) apart.	**6.5.2.2.2 Two-Pipe Changeover System.** Systems that use a common distribution system to supply both heated and chilled water are acceptable provided all of the following are met: a. The system is designed to allow a dead band between changeover from one mode to the other of at least 15°F outdoor air temperature. b. The system is designed to operate and is provided with controls that will allow operation in one mode for at least four hours before changing over to the other mode. c. Reset controls are provided that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F apart.	A review of both documents finds them to be about the same.
C403.4.3.3 Hydronic (water loop) heat pump systems. Hydronic heat pump systems shall comply with Sections C403.4.3.3.1 through C403.4.3.3.3. **C403.4.3.3.1 Temperature dead band.** Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F (11.1°C) between initiation of heat rejection and heat addition by the central devices.	**6.5.2.2.3 Hydronic (Water Loop) Heat Pump Systems.** Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g., cooling tower) and heat additions (e.g., boiler) shall have the following: a. Controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition by the central devices (e.g., tower and boiler). b. For climate zones 3 through 8, if a closed-circuit tower (fluid cooler) is used, either an automatic valve shall be	A review of both documents finds them to be about the same.

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Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on realtime conditions of demand and capacity, dead bands of less than 20°F (11°C) shall be permitted.	installed to bypass all but a minimal flow of water around the tower (for freeze protection) or low-leakage positive closure dampers shall be provided. If an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower. If an open-circuit tower is used in conjunction with a separate heat exchanger to isolate the tower from the heat pump loop, then heat loss shall be controlled by the shutting down the circulation pump on the cooling tower loop. **Exception**: Where a system loop temperature optimization controller is used to determine the most efficient operating temperature based on real-time conditions of demand and capacity, dead bands of less than 20°F shall be allowed.	
C403.4.3.3.2 Heat rejection. Heat rejection equipment shall comply with Sections C403.4.3.3.2.1 and C403.4.3.3.2.2. **Exception:** Where it can be demonstrated that a heat pump system will be required to reject heat throughout the year.	**6.5.5 Heat Rejection Equipment** **6.5.5.1 General.** Section 6.5.5 applies to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers. **Exception:** Heat rejection devices whose energy usage is included in the equipment efficiency ratings listed in Tables 6.8.1A through 6.8.1D.	A review of both documents finds them to be about the same.
C403.4.3.3.2.1 Climate Zones 3 and 4. For Climate Zones 3 and 4: 1. If a closed-circuit cooling tower is used directly in the heat pump loop, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower, or lower leakage positive closure dampers shall be provided. 2. If an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower. 3. If an open- or closed-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the cooling tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.	**6.5.2.2.3 Hydronic (Water Loop) Heat Pump Systems.** Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g., cooling tower) and heat addition (e.g., boiler) shall have the following: a. Controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition by the central devices (e.g., tower and boiler). b. For climate zones 3 through 8, if a closed-circuit tower (fluid cooler) is used, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower (for freeze protection) or low-leakage positive closure dampers shall be provided. If an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat	A review of both documents finds them to be about the same.

2012 IECC	Standard 90.1-10	Comparative Notes
C403.4.3.3.2.2 Climate Zones 5 through 8. For Climate Zones 5 through 8, if an open- or closed-circuit cooling tower is used, then a separate heat exchanger shall be provided to isolate the cooling tower from the heat pump loop, and heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop and providing an automatic valve to stop the flow of fluid.	pump water flow around the tower. If an open-circuit tower is used in conjunction with a separate heat exchanger to isolate the tower from the heat pump loop, then heat loss shall be controlled by the shutting down the circulation pump on the cooling tower loop. **Exception**: Where a system loop temperature optimization controller is used to determine the most efficient operating temperature based on real-time conditions of demand and capacity, dead bands of less than 20°F shall be allowed.	
C403.4.3.3.3 Two position valve. Each hydronic heat pump on the hydronic system having a total pump system power exceeding 10 horsepower (hp) (7.5 kW) shall have a two-position valve.	**6.5.4.4. Hydronic (Water Loop) Heat Pumps and Water-Cooled Unitary Air-Conditioners.** **6.5.4.4.1**Each hydronic heat pump and water-cooled unitary air-conditioners shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off. **Exception:** Units employing water economizers.	The 2012 IECC includes a minimum value for pump power that is not included in Standard 90.1-10 ..
C403.3.2 Hydronic system controls. Hydronic systems of at least 300,000 Btu/h (87 930 W) design output capacity supplying heated and chilled water to comfort conditioning systems shall include controls that meet the requirements of Section C403.4.3. **C403.4.3.4 Part load controls.** Hydronic systems greater than or equal to 300,000 Btu/h (87 930 W) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that have the capability to: 1. Automatically reset the supply-water temperatures using zone-return water temperature, building- return water temperature, or outside air temperature as an indicator of building heating or cooling demand. The temperature shall be capable of being reset by at least 25 percent of the design supply-to-return water temperature difference; or 2. Reduce system pump flow by at least 50 percent of design flow rate utilizing adjustable speed drive(s) on pump(s), or multiple-staged pumps where at least one-half of the total pump horsepower is capable of being automatically turned off or control valves designed to modulate or step down, and close, as a function of load, or other *approved* means.	**6.5.4.3 Chilled- and Hot-Water Temperature Reset Controls.** Chilled- and hot-water systems with a design capacity exceeding 300,000 Btu/h supplying chilled or heated water (or both) to comfort conditioning systems shall include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outdoor air temperature. **Exception:** a. Where the supply temperature reset controls cannot be implemented without causing improper operation of heating, cooling, humidifying, or dehumidifying systems. b. Hydronic systems, such as those required by Section 6.5.4.1 that use variable flow to reduce pumping energy.	The provisions are somewhat the same.

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C403.4.3.5 Pump isolation. Chilled water plants including more than one chiller shall have the capability to reduce flow automatically through the chiller plant when a chiller is shut down. Chillers piped in series for the purpose of increased temperature differential shall be considered as one chiller. Boiler plants including more than one boiler shall have the capability to reduce flow automatically through the boiler plant when a boiler is shut down.	**6.5.4.2 Pump Isolation.** When a chilled-water plant includes more than once chiller, provisions shall be made so that the flow in the chiller plant can be automatically reduced, correspondingly, when a chiller is shut down. Chillers referred to in this section, piped in series for the purposes of increased temperature differential, shall be considered as one chiller. When a boiler plant includes more than one boiler, provisions shall be made sot that the flow in the boiler plant can be automatically reduced, correspondingly, when a boiler is shut down.	A review of both documents finds them to be about the same.
C403.4.4 Heat rejection equipment fan speed control. Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device. **Exception:** Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables C403.2.3(6) and C403.2.3(7).	**6.5.5.1 General**. Section 6.5.5 applies to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers. **Exception:** Heat rejection devices whose energy usage is included in the equipment efficiency ratings listed in Tables 6.8.1A through 6.8.1D.	A review of both documents finds them to be about the same.
C403.4.5 Requirements for complex mechanical systems **serving multiple zones.** Sections C403.4.5.1 through C403.4.5.3 shall apply to complex mechanical systems serving multiple zones. Supply air systems serving multiple zones shall be VAV systems which, during periods of occupancy, are designed and capable of being controlled to reduce primary air supply to each *zone* to one of the following before reheating, recooling or mixing takes place: 1. Thirty percent of the maximum supply air to each *zone*. 2. Three hundred cfm (142 L/s) or less where the maximum flow rate is less than 10 percent of the total fan system supply airflow rate. 3. The minimum ventilation requirements of Chapter 4 of the *International Mechanical Code.* **Exception:** The following define where individual *zones* or where entire air distribution systems are exempted from the requirement for VAV control:	**6.5.2 Simultaneous Heating and Cooling Limitation** **6.5.2.1 Zone Controls.** Zone thermostatic controls shall prevent a. Reheating b. Recooling c. Mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer, and d. Other simultaneous operation of heating and cooling systems to the same zone. **Exceptions:** a. Zones for which the volume of air that is reheated, recooled, or mixed is less than the larger of the following: 1. 30% of the zone design peak supply rate; 2. The outdoor airflow rate required to meet the ventilation requirements of Section 6.2 of ASHRAE Standard 62.1 for the zone; 3. Any higher rate that can be demonstrated, to the	Standard 90.1-10 provides two exceptions for reheat that allow the designer to use reheat if it can be shown that the annual system energy use can be reduced by using a higher air flow rate. The 2012 IECC does not have this exception.

2012 IECC	Standard 90.1-10	Comparative Notes
1. *Zone*s where special pressurization relationships or cross-contamination requirements are such that VAV systems are impractical. 2. *Zones* or supply air systems where at least 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-solar energy source. 3. *Zones* where special humidity levels are required to satisfy process needs. 4. *Zones* with a peak supply air quantity of 300 cfm (142 L/s) or less and where the flow rate is less than 10 percent of the total fan system supply airflow rate. 5. *Zones* where the volume of air to be reheated, recooled or mixed is no greater than the volume of outside air required to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*. 6. *Zones* or supply air systems with thermostatic and humidistatic controls capable of operating in sequence the supply of heating and cooling energy to the *zones* and which are capable of preventing reheating, recooling, mixing or simultaneous supply of air that has been previously cooled, either mechanically or through the use of economizer systems, and air that has been previously mechanically heated.	satisfaction of the authority having jurisdiction, to reduce overall system annual energy losses through a reduction in outdoor air intake for the system. 4. The air flow rate required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates. b. Zones that comply with all of the following: 1. The air flow rate in dead band between heating and cooling does not exceed the larger of the following: i. 20% of the zone design peak supply rate; ii. The outdoor air flow rate required to meet the ventilation requirement of Section 6.2 of ASHRAE 62.1 for the zone; iii. Any higher rate that can be demonstrated, to the satisfaction of the authority having jurisdiction, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in outdoor air intake. 2. The air flow rate that is reheated, recooled, or mixed in peak heating demand shall be less than 50% of the zone design peak supply rate. 3. Airflow between dead band and full heating or full cooling shall be modulated. c. Laboratory exhaust systems that comply with 6.5.7.2 d. Zones where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered (including condenser heat) or site-solar energy source.	
C403.4.5.1 Single duct variable air volume (VAV) systems, terminal devices. Single duct VAV systems shall use terminal devices capable of reducing the supply of primary supply air before reheating or recooling takes place.	**No Comparable Provision**	Standard 90.1-10 does not include provisions specifically for single duct VAV systems and a further analysis should be done on Section 6.5.2.1 to determine if it meets the intent of the 2012 IECC.
C403.4.5.2 Dual duct and mixing VAV systems, terminal devices. Systems that have one warm air duct and one cool air duct shall use terminal devices which are capable of reducing the flow from one duct to a minimum before mixing of air from the other duct takes place.	**No Comparable Provision**	Standard 90.1-10 does not include provisions specifically for single duct VAV systems and a further analysis should be done on Section 6.5.2.1 to determine if it meets the intent of the 2012 IECC.

2012 IECC	Standard 90.1-10	Comparative Notes
C403.4.5.3 Single fan dual duct and mixing VAV systems, economizers. Individual dual duct or mixing heating and cooling systems with a single fan and with total capacities greater than 90,000 Btu/h [(26 375 W) 7.5 tons] shall not be equipped with air economizers.	**No Comparable Provision**	Standard 90.1-10 does not include provisions specifically for single duct VAV systems and a further analysis should be done on Section 6.5.1 and 6.5.2.1 to determine if it meets the intent of the 2012 IECC.
C403.4.5.4 Supply-air temperature reset controls. Multiple *zone* HVAC systems shall include controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls shall be capable of resetting the supply air temperature at least 25 percent of the difference between the design supply-air temperature and the design room air temperature. **Exceptions:** 1. Systems that prevent reheating, recooling or mixing of heated and cooled supply air. 2. Seventy five percent of the energy for reheating is from site-recovered or site solar energy sources. 3. Zones with peak supply air quantities of 300 cfm (142 L/s) or less.	**6.5.3.4 Supply-air temperature reset controls**. Multiple zone HVAC systems must include controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls shall reset the supply air temperature at least 25% of the difference between the design supply-air temperature and the design room air temperature. Controls that adjust the rest based on zone humidity are allowed. Zones which are expected to experience relatively constant loads, such as electronic equipment rooms, shall be designed for the fully reset supply temperatures. **Exceptions:** a. Climate zones 1a, 2a, and 3a b. Systems that prevent re-heating, re-cooling, or mixing of heated and cooled supply air. c. Systems in which at least 75% of the energy for reheating (on an annual basis) is from the site recovered or site solar energy sources.	Standard 90.1-10 exempts supply air temperature reset controls in Climate Zones 1 – 3 where as the 2012 IECC does not. Standard 90.1-10 requires that zones that are expected to see constant loads be designed for the fully reset design temperature.
C403.4.6 Heat recovery for service water heating. Condenser heat recovery shall be installed for heating or reheating of service hot water provided the facility operates 24 hours a day, the total installed heat capacity of watercooled systems exceeds 6,000,000 Btu/hr (1 758 600 W) of heat rejection, and the design service water heating load exceeds 1,000,000 Btu/h (293 100 W). The required heat recovery system shall have the capacity to provide the smaller of: 1. Sixty percent of the peak heat rejection load at design conditions; or 2. The preheating required to raise the peak service hot water draw to 85°F (29°C). **Exceptions:** 1. Facilities that employ condenser heat recovery for space heating or reheat purposes with a heat recovery	**6.5.6.2.1** Condenser heat recovery systems shall be installed for heating or preheating of service hot water provided all of the following are true: a. The facility operates 24 hours a day. b. The total installed heat rejection capacity of the water-cooled systems exceeds 6,000,000 Btu/h of heat rejection. c. The design service water heating load exceeds 1,000,000 Btu/h. **6.5.6.2.2** The required heat recovery system shall have the capacity to provide the smaller of: a. 60% of the peak heat rejection load at design conditions, or b. Preheat of the peak service hot water draw to 85°F. **Exceptions:** a. Facilities that employ condenser heat recovery for space	A review of both documents finds them to be about the same.

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design exceeding 30 percent of the peak water-cooled condenser load at design conditions. 2. Facilities that provide 60 percent of their service water heating from site solar or site recovered energy or from other sources.	heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions. b. Facilities that provide 60% of their service water heating from site-solar or site-recovered energy or from other sources.	
C403.4.7 Hot gas bypass limitation. Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation. The capacity of the hot gas bypass shall be limited as indicated in Table C403.4.7 **Exception:** Unitary packaged systems with cooling capacities not greater than 90,000 Btu/h (26 379 W).	**6.5.9 Hot Gas Bypass Limitation.** Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation. The capacity of the hot gas bypass shall be limited as indicated in Table 6.5.9. **Exception:** Unitary packaged systems with cooling capacities not greater than 90,000 Btu/h.	A review of both documents finds them to be about the same.
SECTION C404 **SERVICE WATER HEATING** **(Mandatory)**	**SECTION 7 SERVICE WATER HEATING**	
	7.2 Compliance Path(s) **7.2.1** Compliance shall be achieved by meeting the requirements of Section 7.1, General; Section 7.4, Mandatory Provisions; Section 7.5, Prescriptive Path; Section 7.7, Submittals; and Section 7.8, Product Information. **7.2.2** Projects using the Energy Cost Budget Method (Section 11) for documentation compliance with the standard shall meet the requirements of Section 7.4, Mandatory Provisions, in conjunction with Section 11, Energy Cost budge Method.	The 2012 IECC does not list compliance paths. All of the requirements in the 2012 IECC are mandatory.
SECTION C404 **SERVICE WATER HEATING** **(Mandatory)**		
C404.1 General. This section covers the minimum efficiency of, and controls for, service water-heating equipment and insulation of service hot water piping.	**7.1 General** **7.1.1 Service Water Heating Scope** **7.1.1.1 New Buildings.** Service water heating systems and equipment shall comply with the requirements of this section as described in Section 7.2. **7.1.1.2 Additions to Existing Buildings.** Service water heating systems and equipment shall comply with the requirements of this section.	Standard 90.1-10 includes language on additions and alterations within the Service Water Heating section. The 2012 IECC covers additions and alterations in Chapter 1. Standard 90.1-10 is more explicit in its requirements than the 2012 IECC.

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	Exception: When the service water heating to an addition is provided by existing service water heating systems and equipment, such systems and equipment shall not be required to comply with this standard. However, any new systems or equipment installed must comply with specific requirements applicable to those systems and equipment. **7.1.1.3 Alterations to Existing Buildings.** Building service water heating equipment installed as a direct replacement for existing building service water heating equipment shall comply with the requirements of Section 7 applicable to the equipment being replaced. New and replacement piping shall comply with Section 7.4.3. **Exception:** Compliance shall not be required where there is insufficient space or access to meet these requirements.	
No Comparable Provision	**7.4.1 Load Calculations**. Service water heating system design loads for the purpose of sizing systems and equipment shall be determined in accordance with manufactures' published sizing guidelines or generally accepted engineering standards and handbooks acceptable to the adopting authority (e.g., ASHRAE Handbook—HVAC Application).	The 2012 IECC has no such provision but Standard 90.1-10, in having one, does not have a sizing limitation, requiring the use of the calculated loads, so this appears to be moot.
No Comparable Provision	**7.5.2 Service Water Heating Equipment**. Service water heating equipment used to provide the additional function of space heating as part of a combination (integrated) system shall satisfy all stated requirements for the service water heating equipment.	The 2012 IECC has no comparable provision.
C404.2 Service water-heating equipment performance efficiency. Water-heating equipment and hot water storage tanks shall meet the requirements of Table C404.2. The efficiency shall be verified through data furnished by the manufacturer or through certification under an *approved* certification program.	**7.4.2 Equipment Efficiency.** All water heating equipment, hot-water supply boilers used solely for heating portable water, pool heaters, and hot-water storage tanks shall meet the criteria listed in Table 7.8. Where multiple criteria are listed, all criteria shall be met. Omission of minimum performance requirements for certain classes of equipment does not preclude use of such equipment where appropriate. Equipment not listed in Table 7.8 has no minimum performance requirements. **Exception:** All water heaters and hot-water supply boilers having more than 140 gal of storage capacity are not required to meet the standby loss (SL) requirements of Table 7.8 when:	Both the 2012 IECC and Standard 90.1-10 use the same water heater efficiency table. Standard 90.1-10 has an exception for meeting a minimum energy factor for water heaters with a storage capacity exceeding 140 gallons.

2012 IECC	Standard 90.1-10	Comparative Notes
	a. The tank surface is thermally insulated to R-12.5 b. A standing pilot light is not installed c. Gas- or oil-fired storage water heaters have a flue damper or fan-assisted combustion.	
C404.3 Temperature controls. Service water-heating equipment shall be provided with controls to allow a setpoint of 110°F (43°C) for equipment serving dwelling units and 90°F (32°C) for equipment serving other occupancies. The outlet temperature of lavatories in public facility rest rooms shall be limited to 110°F (43°C).	**7.4.4.1 Temperature Controls.** Temperature controls shall be provided that allow for storage temperature adjustment from 120°F or lower to a maximum temperature compatible with the intended use. **Exception:** When the manufactures' installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion. **7.4.4.3 Outlet Temperature Controls.** Temperature controlling means shall be provided to limit the maximum temperature of water delivered from lavatory faucets in public facility restrooms to 110°F	A comparison of the documents indicates that they are compatible.
	7.4.4.4 Circulating Pump Controls. When used to maintain storage tank water temperature, recirculating pumps shall be equipped with controls limiting operation to a period from the start of the heating cycle to a maximum of five minutes after the end of the heating cycle.	The 2012 IECC does not contain a comparable provision and could therefore be considered less stringent than Standard 90.1-10.
C404.4 Heat traps. Water-heating equipment not supplied with integral heat traps and serving noncirculating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment.	**7.4.6 Heat Traps**. Vertical pipe risers serving storage water heaters and storage tanks not having integral heat traps and serving nonrecirculating systems shall have heat traps on both the inlet and outlet piping as close as practical to the storage tank. A heat trap is a means to counteract the natural convection of heated water in a vertical pipe run. The means is either a device specifically designed for the purpose or an arrangement of tubing that forms a loop of 360 degrees or piping that from the point of connection to the water heater (inlet or outlet) includes a length of piping directed downward before connection to the vertical piping of the supply water or hot-water distribution system, as applicable.	The text in both documents seems compatible.
C404.5 Pipe insulation. For automatic-circulating hot water and heat-traced systems, piping shall be insulated with not less than 1 inch (25 mm) of insulation having a conductivity not exceeding 0.27 Btu per inch/h × ft^2 × °F (1.53 W per 25 mm/m^2 × K). The first 8 feet (2438 mm) of piping in non-hotwater-supply temperature maintenance systems served by equipment without integral heat traps shall be insulated with 0.5 inch (12.7	**7.4.3 Service Hot-Water Piping Insulation**. The following piping shall be insulated to levels shown in Section 6, Table 6.8.3: a. Recirculating system piping, including the supply and return piping of a circulating tank type water heater b. The first 8 ft. of outlet piping for a constant temperature nonrecirculating storage system. c. The inlet pipe between the storage tank and a heat trap in	The requirements for noncirculating piping insulation are more stringent in Standard 90.1-10. .

2012 IECC	Standard 90.1-10	Comparative Notes
mm) of material having a conductivity not exceeding 0.27 Btu per inch/h × ft^2 × °F (1.53 W per 25 mm/m^2 × K). **Exception:** Heat-traced piping systems shall meet the insulation thickness requirements per the manufacturer's installation instructions. Untraced piping within a heat traced system shall be insulated with not less than 1 inch (25 mm) of insulation having a conductivity not exceeding 0.27 Btu per inch/h × ft^2 × °F (1.53 W per 25 mm/m^2 × K).	a nonrecirculating storage system d. Pipes that are externally heated (such as heat trace or impedance heating).	
C404.6 Hot water system controls. Circulating hot water system pumps or heat trace shall be arranged to be turned off either automatically or manually when there is limited hot water demand. Ready access shall be provided to the operating controls.	**7.4.4.2 Temperature Maintenance Controls**. Systems designed to maintain usage temperatures in hot-water pipes, such as recirculating hot-water systems or heat trace, shall be equipped with automatic time switches or other controls that can be set to switch off the usage temperature maintenance system during extended periods when hot water is not required.	The requirements in both documents are about the same.
C404.7 Pools and inground permanently installed spas (Mandatory). Pools and inground permanently installed spas shall comply with Sections C404.7.1 through C404.7.3.		
C404.7.1 Heaters. All heaters shall be equipped with a readily *accessible* on-off switch that is mounted outside of the heater to allow shutting off the heater without adjusting the thermostat setting. Gas-fired heaters shall not be equipped with constant burning pilot lights.	**7.4.5.1 Pool Heaters.** Pool heaters shall be equipped with a readily accessible on/off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.	The requirements in both documents are about the same.
C404.7.2 Time switches. Time switches or other control method that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on all heaters and pumps. Heaters, pumps and motors that have built in timers shall be deemed in compliance with this requirement. **Exceptions:** 1. Where public health standards require 24-hour pump operation. 2. Where pumps are required to operate solar- and waste-heat-recovery pool heating systems.	**7.4.5.3 Time switches**. Time switches shall be installed on swimming pool heaters and pumps. **Exceptions:** a. Where public health standards require 24-hour pump operation. b. Where pumps are required to operate solar and waste heat recovery pool heating systems.	The requirements in both documents are about the same.

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C404.7.3 Covers. Heated pools and inground permanently installed spas shall be provided with a vapor-retardant cover. **Exception:** A vapor-retardant cover is not required for pools deriving over 70 percent of the energy for heating from site-recovered energy, such as a heat pump or solar energy source computed over an operating season.	**7.4.5.2 Pool Covers.** Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F shall have a pool cover with a minimum insulation value of R-12. **Exception:** Pools deriving over 60% of the energy for heating from site-recovered energy or solar energy source.	The 2012 IECC requires a vapor retardant cover and Standard 90.1-10 requires an insulated pool cover for pools heated to greater than 90°F . Exceptions differ by with IECC exempting systems with 70 percent of energy from site-recovery or solar energy and ASHRAE exempting those with 60 percent from the same sources.
	7.7 Submittals **7.7.1 General.** The authority having jurisdiction may require submittals of compliance documentation and supplemental information, in accord with Section 4.2.2 of this standard.	The provisions in both are similar. The 2012 IECC includes similar language in Section C103.
SECTION C405 **ELECTRICAL POWER AND LIGHTING SYSTEMS (MANDATORY)**		
C405.1 General (Mandatory). This section covers lighting system controls, the connection of ballasts, the maximum lighting power for interior applications, electrical energy consumption, and minimum acceptable lighting equipment for exterior applications. **Exception:** Dwelling units within commercial buildings shall not be required to comply with Sections C405.2 through C405.5 provided that not less than 75 percent of the permanently installed light fixtures, other than low voltage lighting, shall be fitted for, and contain only, high efficacy lamps.	**9.1.1 Scope** This section shall apply to the following: a. Interior spaces of buildings b. Exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies c. Exterior building grounds lighting provided through the building's electrical service **Exceptions:** a. Emergency lighting that is automatically off during normal building operation b. Lighting within dwelling units c. Lighting that is specifically designated as required by a health or life safety statute, ordinance d. Or regulation decorative gas lighting systems	Both Standard 90.1-10 and the 2012 IECC include the same scope for interior and exterior lighting. The 2012 IECC has provisions that cover residential lighting.
	9.1.2 Lighting Alterations. The alteration of lighting systems in any building space or exterior area shall comply with the lighting power density (LPD) requirements of Section 9 applicable to that space or area and the automatic shutoff requirements of 9.4.1.1. Such alterations shall include all luminaires that are added, replaced or removed. This requirement shall also be met for alterations that involve only the replacement of lamps plus ballasts. Alterations do not include routine maintenance or	Standard 90.1-10 is more stringent on how it deals with lighting alterations allowing less than 10% of the lighting to be altered before compliance must be demonstrated for the lighting system.

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	repair situations. **Exceptions:** Alterations that involve less than 10% of the connected lighting load in a space or area need not comply with these requirements provided that such alterations do not increase the installed LPD.	
C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls as specified in Sections C405.2.1, C405.2.2, C405.2.3 and C405.2.4.	**9.4.1 Lighting Control** Building controls shall meet the provisions of 9.4.1.1, 9.4.1.2, 9.4.1.3, 9.4.1.4, 9.4.1.5, 9.4.1.6, and 9.4.1.7. Any automatic control device required in sections 9.4.1.1, 9.4.1.2, and 9.4.1.4 shall either be manual on or shall be controlled automatically turn the lighting on to not more than 50% power, except in the following spaces where full automatic-on is allowed; a. Public corridors and stairwells, b. Restrooms, c. Primary building entrance areas and lobbies, and d. Areas where manual-on operation would endanger the safety or security of the room or building occupant(s).	Standard 90.1-10 and the 2012 IECC cover include similar lighting control requirements. The differences will be identified below.
C405.2.1 Manual lighting controls. All buildings shall include manual lighting controls that meet the requirements of Sections C405.2.1.1 and C405.2.1.2. **C405.2.1.1 Interior lighting controls.** Each area enclosed by walls or floor-to-ceiling partitions shall have at least one manual control for the lighting serving that area. The required controls shall be located within the area served by the controls or be a remote switch that identifies the lights served and indicates their status. **Exceptions:** 1. Areas designated as security or emergency areas that need to be continuously lighted. 2. Lighting in stairways or corridors that are elements of the means of egress. **C405.2.1.2 Light reduction controls.** Each area that is required to have a manual control shall also allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent.	**9.4.1 Lighting Control.** Building controls shall meet the provisions of 9.4.1.1, 9.4.1.2, 9.4.1.3, 9.4.1.4, 9.4.1.5, 9.4.1.6, and 9.4.1.7. Any automatic control device required in sections 9.4.1.1, 9.4.1.2, and 9.4.1.4 shall either be manual on or shall be controlled to automatically turn the lighting on to not more than 50% power, except in the following spaces where full automatic-on is allowed. a. Public corridors and stairwells, b. Restrooms, c. Primary building entrance areas and lobbies, and d. Areas where manual-on operation would endanger the safety or security of the room or building occupant(s).	Both the 2012 IECC and Standard 90.1-10 require independent lighting controls for each space. The 2012 IECC also requires light reduction controls. Both also require automatic controls under specific circumstances.

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Lighting reduction shall be achieved by one of the following or other *approved* method: 1. Controlling all lamps or luminaires; 2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps; 3. Switching the middle lamp luminaires independently of the outer lamps; or 4. Switching each luminaire or each lamp. **Exception:** Light reduction controls need not be provided in the following areas and spaces: 1. Areas that have only one luminaire, with rated power less than 100 watts. 2. Areas that are controlled by an occupant-sensing device. 3. Corridors, equipment rooms, storerooms, restrooms, public lobbies, electrical or mechanical rooms. 4. *Sleeping unit* (see Section C405.2.3). 5. Spaces that use less than 0.6 watts per square foot (6.5 W/m2). 6. Daylight spaces complying with Section C405.2.2.3.2.		
C405.2.2 Additional lighting controls. Each area that is required to have a manual control shall also have controls that meet the requirements of Sections C405.2.2.1, C405.2.2.2 and C405.2.2.3. **Exception:** Additional lighting controls need not be provided in the following spaces: 1. *Sleeping units*. 2. Spaces where patient care is directly provided. 3. Spaces where an automatic shutoff would endanger occupant safety or security. 4. Lighting intended for continuous operation. **C405.2.2.1 Automatic time switch control devices.** Automatic time switch controls shall be installed to control lighting in all areas of the building. **Exceptions:** 1. Emergency egress lighting does not need to be	**9.4.1 Lighting Control.** Building controls shall meet the provisions of 9.4.1.1, 9.4.1.2, 9.4.1.3, 9.4.1.4, 9.4.1.5, 9.4.1.6, and 9.4.1.7. Any automatic control device required in sections 9.4.1.1, 9.4.1.2, and 9.4.1.4 shall either be manual on or shall be controlled to automatically turn the lighting on to not more than 50% power, except in the following spaces where full automatic-on is allowed. a. Public corridors and stairwells, b. Restrooms, c. Primary building entrance areas and lobbies, and Areas where manual-on operation would endanger the safety or security of the room or building occupant(s). **9.4.1.1 Automatic Lighting Shutoff.** Interior lighting in buildings shall be controlled with an automatic control device to shut off building lighting in all spaces. This automatic control device shall function on either a. A scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times—an independent program	Both the 2012 IECC and Standard 90.1-10 require automatic lighting controls in addition to manual controls each for each area. Both allow the use of either a automatic time control or an occupancy sensor. Standard 90.1-2010 is more specific on where occupancy sensors are required to be used. The 2012 IECC requires additional controls for all daylit zones that can be manual where as Standard 90.1-10 has minimum space limitations where controls for daylighting are required but the controls must be automatic so is more stringent for spaces exceeding the minimum space limitations.

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controlled by an automatic time switch. 2. Lighting in spaces controlled by occupancy sensors does not need to be controlled by automatic time switch controls. The automatic time switch control device shall include an override switching device that complies with the following: 1. The override switch shall be in a readily accessible location; 2. The override switch shall be located where the lights controlled by the switch are visible; or the switch shall provide a mechanism which announces the area controlled by the switch; 3. The override switch shall permit manual operation; 4. The override switch, when initiated, shall permit the controlled lighting to remain on for a maximum of 2 hours; and 5. Any individual override switch shall control the lighting for a maximum area of 5,000 square feet (465 m^2). **Exception:** Within malls, arcades, auditoriums, single tenant retail spaces, industrial facilities and arenas: 1. The time limit shall be permitted to exceed 2 hours provided the override switch is a captive key device; and 2. The area controlled by the override switch is permitted to exceed 5,000 square feet (465 m^2), but shall not exceed 20,000 square feet (1860 m^2). **C405.2.2.2 Occupancy sensors.** Occupancy sensors shall be installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, and other spaces 300 square feet (28 m^2) or less enclosed by floor-to-ceiling height partitions. These automatic control devices shall be installed to automatically turn off lights within 30 minutes of all occupants leaving the space, and shall either be manual on or shall be controlled to automatically turn the lighting on to not more than 50 percent power. **Exception:** Full automatic-on controls shall be	schedule shall be provided for areas of no more than 25,00 ft2 but not more than one floor—or b. An occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space, or c. A signal from another control or alarm system that indicates the area that is unoccupied. **9.4.1.2 Space Control.** Each space enclosed by ceiling by ceiling-height partitions shall have at least one control device to independently control the general lighting within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting. All controlled lighting shall meet the following requirements: a. The controlled lighting shall have at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off. b. An occupant sensor or a timer switch shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space in: 1. Classrooms and lecture halls, 2. Conference, meeting, and training rooms, 3. Employee lunch and break rooms, 4. Storage and supply rooms between 50ft2 and 1000 ft2, 5. Rooms used for document copying and printing, 6. Office spaces up to 250 ft2, 7. Restrooms, 8. And dressing, locker, and fitting rooms. Exceptions to 9.4.1.2b: These spaces are not required to be connected to other automatic lighting shutoff controls: 1. Spaces with multi-scene control systems, 2. Shop and laboratory classrooms, 3. Spaces where an automatic shutoff would endanger the safety or security of the room and building occupant(s), and Lighting required for 24-hour operation.	

2012 IECC	Standard 90.1-10	Comparative Notes
permitted to control lighting in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants **C405.2.2.3 Daylight zone control.** Daylight zones shall be designed such that lights in the daylight zone are controlled independently of general area lighting and are controlled in accordance with either Section C405.2.2.3.1 or Section C405.2.2.3.2. Each daylight control zone shall not exceed 2,500 square feet (232 m^2). Contiguous daylight zones adjacent to vertical fenestration are allowed to be controlled by a single controlling device provided that they do not include zones facing more than two adjacent cardinal orientations (i.e., north, east, south, west). Daylight zones under skylights more than 15 feet (4572 mm) from the perimeter shall be controlled separately from daylight zones adjacent to vertical fenestration. **Exception:** Daylight zones enclosed by walls or ceiling height partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.		
C405.5 Interior lighting power requirements (Prescriptive). A building complies with this section if its total connected lighting power calculated under Section C405.5.1 is no greater than the interior lighting power calculated under Section C405.5.2. **C405.5.1 Total connected interior lighting power.** The total connected interior lighting power (watts) shall be the sum of the watts of all interior lighting equipment as determined in accordance with Sections C405.5.1.1 through C405.5.1.4. **Exceptions:** 1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power. 1.1. Professional sports arena playing field lighting.	**9.2.2.3 Interior Lighting Power** The interior lighting power allowance for a building or a separately metered or permitted portion of a building shall be determined by either the Building Area Method described in Section 9.5 or the Space-by-Space Method described in Section 9.6. Trade-offs of interior lighting power allowance among portions of the building for which a different method of calculation has been used are not permitted. The installed interior lighting power identified in accordance with Section 9.1.3 shall not exceed the interior lighting power allowance developed in accordance with Section 9.5 or 9.6. **Exceptions:** The following lighting equipment and applications shall not be considered when determining the interior lighting power allowance developed in accordance with Section 9.5 or 9.6, nor shall the wattage for such lighting be included in the installed interior lighting power identified with accordance 9.1.3. However, any such lighting shall not	Both Standard 90.1-10 and the 2012 IECC include a whole building and space by space approach for calculating lighting power. The lighting power densities in Standard 90.1-10 are more stringent. Both have similar exceptions.

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1.2. *Sleeping unit* lighting in hotels, motels, boarding houses or similar buildings. 1.3. Emergency lighting automatically off during normal building operation. 1.4. Lighting in spaces specifically designed for use by occupants with special lighting needs including the visually impaired visual impairment and other medical and age-related issues. 1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark. 1.6. Casino gaming areas. 2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device: 2.1. Task lighting for medical and dental purposes. 2.2. Display lighting for exhibits in galleries, museums and monuments. 3. Lighting for theatrical purposes, including performance, stage, film production and video production. 4. Lighting for photographic processes. 5. Lighting integral to equipment or instrumentation and is installed by the manufacturer. 6. Task lighting for plant growth or maintenance. 7. Advertising signage or directional signage. 8. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment. 9. Lighting equipment that is for sale. 10. Lighting demonstration equipment in lighting education facilities. 11. Lighting *approved* because of safety or emergency considerations, inclusive of exit lights. 12. Lighting integral to both open and glass enclosed refrigerator and freezer cases. 13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions. 14. Furniture mounted supplemental task lighting that is controlled by automatic shutoff.	be except unless it is an addition to general lighting and is controlled by an independent control device. a. Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments. b. Lighting that is integral to equipment or instrumentation and is installed by its manufacturer. c. Lighting specifically designed for use only during medic al or dental procedures and lighting integral to medical equipment. d. Lighting integral to both open and glass-enclosed refrigerator and freezer cases. e. Lighting integral to food warming and food preparation equipment. f. Lighting for plant growth or maintenance. g. Lighting in spaces specifically designed for use by occupants with special lighting needs including visual impairment and other medical and age-related issues. h. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions. i. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark. j. Lighting that is an integral part of advertising or directional signage. k. Exit signs l. Lighting that is for sale or lighting educational demonstration systems. m. Lighting for theatrical purposes, including performance, stage, and film and video production. n. Lighting for television broadcasting in sporting activity areas. o. Casino gaming areas. p. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff and complies with Section 9.4.1.6(d). q. Mirror lighting in dressing rooms and accent lighting in religious pulpit and choir areas. r. Parking garage transition lighting: Lighting for covered vehicle entrances and exits from buildings and parking structures, that comply with Section 9.4.1.3 a and c. Each transition zone shall not exceed a depth of 66 ft inside the structure and a width of 50 ft.	

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C405.2.3 Specific application controls. Specific application controls shall be provided for the following: 1. Display and accent light shall be controlled by a dedicated control which is independent of the controls for other lighting within the room or space. 2. Lighting in cases used for display case purposes shall be controlled by a dedicated control which is independent of the controls for other lighting within the room or space. 3. Hotel and motel sleeping units and guest suites shall have a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles. 4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided the control device is readily accessible. 5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control which is independent of the controls for other lighting within the room or space. 6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control which is independent of the controls for other lighting within the room or space.	**9.4.1.6 Additional Control:** Additional controls shall meet the following requirements: a. Display/Accent lighting—display or accent lighting shall have a separate control device. b. Case lighting—lighting in cases used for display purposes shall have a separate control device. c. Guest Room Lighting—Guestrooms in hotels, motels, boarding houses or similar buildings shall have one or more control device(s) at the entry door that collectively control all permanently installed luminaires and switched receptacles, except those in the bathroom(s). Suites shall have control(s) meeting these requirements at the entry to each room or at the primary entry to the suite. Bathrooms shall have a control device installed to automatically turn off the bathroom lighting, except for night lighting not exceeding 5 watts, within 60 minutes of the occupant leaving the space. d. Task Lighting—supplement task lighting, including permanently installed undershelf or undercabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided the control device is readily accessible and located so that the occupant can see the controlled lighting. e. Nonvisual Lighting—lighting for nonvisual applications, such as plant growth and food warming, shall have separate control device. f. Demonstration Lighting—lighting equipment that is for sale or for demonstrations in lighting education shall have a separate control device. g. Stairwell Lighting—Lighting in stairwells shall have one or more control devices to automatically reduce lighting power in any one controlled zone by at least 50% within 30 minutes of all occupants leaving that controlled zone.	The additional control language is similar.
C405.2.2.3.1 Manual daylighting controls. Manual controls shall be installed in daylight zones unless automatic controls are installed in accordance with Section C405.2.2.3.2. **C405.2.2.3.2 Automatic daylighting controls.** Set-point and other controls for calibrating the lighting control device shall be readily accessible. Daylighting	**9.4.1.4 Automatic Daylighting Controls for Primary Sidelighted Areas**. When the combined primary sidelighted area in an enclosed space equals or exceeds 250 ft^2, the lamps for general lighting in the primary sidelighted area shall be separately controlled by at least one multilevel photocontrol (including continuous dimming devices) having the following characteristics: a. The light sensor for the photocontrol shall be remote	Standard 90.1-10 requires automatic daylighting controls for all daylit spaces over a minimum area. The 2012 IECC allows manual controls in daylit zones except where credit is taken for increased vertical horizontal fenestration area or where skylights are required. The automatic daylight control is similar for each.

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controls device shall be capable of automatically reducing the lighting power in response to available daylight by either one of the following methods: 1. Continuous dimming using dimming ballasts and daylight-sensing automatic controls that are capable of reducing the power of general lighting in the daylit zone continuously to less than 35 percent of rated power at maximum light output. 2. Stepped dimming using multi-level switching and daylight-sensing controls that are capable of reducing lighting power automatically. The system shall provide a minimum of two control channels per zone and be installed in a manner such that at least one control step is between 50 percent and 70 percent of design lighting power and another control step is no greater than 35 percent of design power. **C405.2.2.3.3 Multi-level lighting controls.** Where multi-level lighting controls are required by this code, the general lighting in the daylight zone shall be separately controlled by at least one multi-level lighting control that reduces the lighting power in response to daylight available in the space. Where the daylit illuminance in the space is greater than the rated illuminance of the general lighting of daylight zones, the general lighting shall be automatically controlled so that its power draw is no greater than 35 percent of its rated power. The multi-level lighting control shall be located so that calibration and set point adjustment controls are readily accessible and separate from the light sensor.	from where calibration adjustments are made; b. The calibration adjustments shall be readily accessible and c. The multilevel photocontrol shall reduce electric lighting in response to available daylight with at least one control step that is between 50% and 70% of design lighting power and another control step that is no greater than 35% (including off) of power design. **Exceptions:** a. Primary sidelighted areas where the top of the existing adjacent structures are twice as high above the windows as their distance away from the windows. b. Primary sidelighted areas where the sidelighting effective aperture is less than 0.1 (10%) c. Retail spaces. **9.4.1.5 Automatic Daylighting Controls for Toplighting**. When the total daylight area under skylights plus the total daylight area under rooftop monitors in an enclosed space exceeds 900 ft^2, the lamps for general lighting in the daylight area shall be separately controlled by at least one multilevel photocontrol (including continuous dimming devices) having the following characteristics: a. the light sensor for the photocontrol shall be remote from where calibration adjustments are made, b. the calibration adjustments shall be readily accessible, and, c. the multilevel photocontrol shall reduce electric lighting in response to available daylight with at least one control step that is between 50% and 70% of design lighting power and another control step that is no greater than 35% of design power. **Exceptions:** a. Daylighted areas under skylights where it is documented that existing adjacent structures or natural objects block direct beam sunlight for more than 1500 daytime hours per year between 8 a.m. and 4 p.m. b. Daylighted areas where the skylight effective aperture (EA) is less than -.006 (0.6%) c. Buildings in climate zone 8 with daylight areas totaling less than 1,500 ft^2 in an enclosed space.	

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	9.4.1.3 Parking Garage Lighting Control. Lighting for parking garages shall comply with the following requirements: a. Comply with section 9.4.1.1. b. Lighting shall be controlled by one or more devices that automatically reduce lighting power of each luminaire by a minimum of 30% when there is no activity detected within a lighting zone for no more than 30 minutes. Lighting zones for this requirement shall be no larger than 3,600 ft2, c. Daylight transition zone lighting, as described in Section 9.2.2.3 exception r, shall be separately controlled by a device that automatically turn lighting on during daylight hours and off at sunset. d. For luminaires within 20ft of any perimeter wall structure that has a net opening to wall ratio of at least 40% and no exterior obstructions within 20ft, the power shall be automatically reduced in response to daylight. **Exceptions:** a. Daylight transitions zones and ramps without parking are exempt from sections b and d above. b. Applications using HID of 150 watts or less or Induction lamps are exempt from section b above.	The 2012 IECC has no comparable provision. Standard 90.1-10 is more stringent for lighting controls for parking garages.
C405.2.4 Exterior lighting controls. Lighting not designated for dusk-to-dawn operation shall be controlled by either a combination of a photosensor and a time switch, or an astronomical time switch. Lighting designated for dusk-to-dawn operation shall be controlled by an astronomical time switch or photosensor. All time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least 10 hours.	**9.4.1.7 Exterior Lighting control.** Lighting for exterior applications not exempted in section 9.1 shall meet the following requirements: a. Lighting shall be controlled by a device that automatically turns off the lighting when sufficient daylight is available. b. All building façade and landscape lighting shall be automatically shut off between midnight or business closing, whichever is later, and 6am or business opening, whichever comes first, or between times established by the authority having jurisdiction. c. Lighting not specified in Section B above, including advertising signage, shall be controlled by a device that automatically reduces the connected lighting power by at least 30% for at least one of the following conditions a. From 12 midnight or within one (1) hour of the end of business operations, whichever is later, until 6am or business opening,	Standard 90.1-10 requires more specific time periods when exterior lighting will be shut off and also includes signage which is exempt in the 2012 IECC by stating that only exterior lights not designated for dusk to dawn operation must comply. Standard 90.1-10 is more stringent.

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	whichever is earlier; b. Or during any period when no activity has been detected for a time of longer than 15 minutes. All time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least ten hours. **Exception**: Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.	
C405.3 Tandem wiring (Mandatory). The following luminaires located within the same area shall be tandem wired: 1. Fluorescent luminaires equipped with one, three or odd-numbered lamp configurations, that are recess mounted within 10 feet (3048 mm) center-to-center of each other. 2. Fluorescent luminaires equipped with one, three or any odd-numbered lamp configuration, that are pendant- or surface-mounted within 1 foot (305 mm) edge-to-edge of each other. **Exceptions:** 1. Where electronic high-frequency ballasts are used. 2. Luminaires on emergency circuits. 3. Luminaires with no available pair in the same area.	**No Comparable Provision**	No parallel provision exists in Standard 90.1-10 but given the current lighting technology installed in buildings this requirement is rarely implemented.
C405.4 Exit signs (Mandatory). Internally illuminated exit signs shall not exceed 5 watts per side.	**9.4.2 Exit Signs.** Internally illuminated exit signs shall not exceed 5 W per face.	The requirements in both documents are the same.
C405.5.1.1 Screw lamp holders. The wattage shall be the maximum *labeled* wattage of the luminaire.	**9.1.4 Interior and Exterior Luminaire Wattage.** Luminaire wattage, when used to calculate either installed interior lighting power or installed exterior lighting power, shall be determined in accordance with the following criteria: a. The wattage of line-voltage luminaires not containing permanently installed ballasts, transformers, or similar devices shall be the manufacturer's labeled maximum-wattage of the luminaire.	The provisions are the same.
C405.5.1.2 Low-voltage lighting. The wattage shall be the specified wattage of the transformer supplying the system.	**9.1.4 Interior and Exterior Luminaire Wattage.** Luminaire wattage, when used to calculate either installed interior lighting power or installed exterior lighting power, shall be determined in accordance with the following criteria: a. The wattage of low-voltage lighting track, cable	The provisions are similar.

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	conductor, rail conductor, and other flexible lighting systems that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.	
C405.5.1.3 Other luminaires. The wattage of all other lighting equipment shall be the wattage of the lighting equipment verified through data furnished by the manufacturer or other *approved* sources.	**9.1.4 Interior and Exterior Luminaire Wattage.** Luminaire wattage, when used to calculate either installed interior lighting power or installed exterior lighting power, shall be determined in accordance with the following criteria: a. The wattage of all other miscellaneous lighting equipment shall be the specified wattage of the lighting equipment.	The provisions are similar**.**
C405.5.1.4 Line-voltage lighting track and plug-in busway. The wattage shall be: 1. The specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft. (98 W/lin. m); 2. The wattage limit of the system's circuit breaker; or 3. The wattage limit of other permanent current limiting device(s) on the system.	**9.1.4 Interior and Exterior Luminaire Wattage.** Luminaire wattage, when used to calculate either installed interior lighting power or installed exterior lighting power, shall be determined in accordance with the following criteria: a. For line-voltage lighting track and plug-in busway, designed to allow the addition and/or relocation of luminaires without altering the wiring of the system, the wattage shall be 1. The specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft or 2. The wattage limit of the system's circuit breaker or 3. The wattage limit of other permanent current-limiting device(s) on the system.	The provisions are similar.
C405.5.2 Interior lighting power. The total interior lighting power allowance (watts) is determined according to Table C405.5.2(1) using the Building Area Method, or Table C405.5.2(2) using the Space-by-Space Method, for all areas of the building covered in this permit. For the Building Area Method, the interior lighting power allowance is the floor area for each building area type listed in Table C405.5.2(1) times the value from Table C405.5.2(1) for that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type as listed in Table C405.5.2(1). Where this method is used to calculate the total interior lighting power for an entire	**9.6.1 Space-by-space Method of Calculating Interior Lighting Power Allowance.** Use the following steps to determine the interior lighting power allowance by the Space-by-Space Method: a. For each space enclosed by partitions that are 80% of the ceiling height or taller, determine the appropriate space type from Table 9.6.1. If a space has multiple functions, where more than one space is applicable, that space shall be broken up into smaller subspaces, each using their own space type from Table 9.6.1. Any of these subspaces that are smaller in floor area than 20% of the original space and less than 1000ft2 need not be broken out separately. Include the floor area of balconies and other projections in this calculation.	Standard 90.1-10 is more stringent for the Lighting Power Densities for several use types.

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building, each building area type shall be treated as a separate area. For the Space-by-Space Method, the interior lighting power allowance is determined by multiplying the floor area of each space times the value for the space type in Table C405.5.2(2) that most closely represents the proposed use of the space, and then summing the lighting power allowances for all spaces. Tradeoffs among spaces are permitted.	b. In calculating the area of each space and subspace, the limits of the area are defined by the centerline of interior walls, the dividing line between subspaces, and the outside surface of exterior walls. c. Based on the space type selected for each space or subspace, determine the lighting power allowance of each space or subspace by multiplying the calculated area of the space or subspace by the appropriate LPD determined in 9.6.1(a). For space types not listed, selection of a reasonable equivalent category shall be permitted. d. The interior lighting power allowance is the sum of lighting power allowances of all spaces and subspaces. Tradeoffs among spaces and subspaces are permitted provided that the total installed interior lighting power does not exceed the interior lighting power allowance.	
C405.6 Exterior lighting (Mandatory). Where the power for exterior lighting is supplied through the energy service to the building, all exterior lighting, other than low-voltage landscape lighting, shall comply with Sections C405.6.1 and C405.6.2. **Exception:** Where *approved* because of historical, safety, signage or emergency considerations. **C405.6.2 Exterior building lighting power.** The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated and are permitted in Table C405.6.2(2) for the applicable lighting zone. Tradeoffs are allowed only among exterior lighting applications listed in Table C405.6.2(2), Tradable Surfaces section. The lighting zone for the building exterior is determined from Table C405.6.2(1) unless otherwise specified by the local jurisdiction. Exterior lighting for all applications (except those included in the exceptions to Section C405.6.2) shall comply with the requirements of Section C405.6.1. **Exception:** Lighting used for the following exterior applications is exempt where equipped with a control device independent of the control of the nonexempt lighting:	**9.4.3 Exterior Building Lighting Power.** The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are designated to be illuminated and are permitted in Table 9.4.3B for the applicable lighting zone. The installed exterior lighting power identified in accordance with Section 9.1.3 shall not exceed the exterior lighting power allowance developed in accordance with this section. Trade-offs are allowed only among exterior lighting applications listed in the Table 9.4.3B "Tradable Surfaces" section. The lighting zone for the building exterior is determined from Table 9.4.3A unless otherwise specified by the local jurisdiction. **Exceptions:** Lighting used for the following exterior applications is exempt when equipped with a control device that complies with the requirements of Section 9.4.1.7 and is independent of the control of the nonexempt lighting: a. Specialized signal, directional, and marker lighting associated with transportation. b. Advertising signage or directional signage. c. Lighting integral to equipment or instrumentation and installed by its manufacturer. d. Lighting for theatrical purposes, including performance, stage, film production, and video production. e. Lighting for athletic playing areas. f. Temporary lighting.	The exterior Lighting Power Allowances included in Standard 90.1-10 and the 2012 IECC are identical except for Zone 0 contained in Standard 90.1-10. This zone will have limited use.

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1. Specialized signal, directional and marker lighting associated with transportation; 2. Advertising signage or directional signage; 3. Integral to equipment or instrumentation and is installed by its manufacturer; 4. Theatrical purposes, including performance, stage, film production and video production; 5. Athletic playing areas; 6. Temporary lighting; 7. Industrial production, material handling, transportation sites and associated storage areas; 8. Theme elements in theme/amusement parks; and 9. Used to highlight features of public monuments and registered historic landmark structures or buildings.	g. Lighting for industrial production, material handling, transportation sites, and associated storage areas. h. Theme elements in theme/amusement parks. i. Lighting used to highlight features of public monuments and registered historic landmark structures or buildings. j. Lighting for hazardous locations. k. Lighting for swimming pools and water features. l. Searchlights.	
C405.6.1 Exterior building grounds lighting. All exterior building grounds luminaires that operate at greater than 100 watts shall contain lamps having a minimum efficacy of 60 lumens per watt unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Section C405.6.2.	**No Comparable Provision**	Standard 90.1-10 does not contain a comparable provision.
No Comparable Provision	**9.4.4 Functional Testing**. Lighting control device and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions. When occupants' sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed. a. Confirm that the placement, sensitivity, and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied. b. Confirm that the time switches and programmable schedule controls are programmed to turn the lights off. c. Confirm that photosensor controls reduce electric light levels based on the amount of usable daylight in the space as specified. The construction documents shall state the party who will conduct and certify the functional testing. The party responsible for the functional testing shall not be directly involved in either the design or construction of the project and shall provide documentation certifying that the installed	The 2012 IECC Contains a requirement for functional testing for lighting in Section C408.3 that is comparable to this provision.

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	lighting controls meet or exceed all documentation performance criteria. Certification shall be specific enough to verify conformance.	
C405.7 Electrical energy consumption (Mandatory). In buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.	**No Comparable Provision**	Standard 90.1-10 has no comparable provision making the 2012 IECC more stringent.
	9.7 Submittals	
	9.7.1 General. Where required by the authority having jurisdiction the submittal of compliance documentation and supplemental information shall be in accordance with section 4.2.2.	The 2012 IECC has similar provisions under C103.
	9.7.2 Completion requirements. The following requirements are mandatory provisions and are necessary for compliance with this standard. **9.7.2.1. Drawing**. Construction documents shall require that within 90 days after the date of system acceptance, record drawings of the actual installation be provided to the building owner or the designated representative of the building owner. Record drawings shall include, as a minimum, the location, luminaire identifier, control, and circuiting for each piece of lighting equipment. **9.7.2.2 Manuals.** Construction documents shall require for all lighting equipment and lighting controls, an operating and maintenance manual be provided to the building owner or the designated representative of the building owner within 90 days after the date of system acceptance. These manuals shall include, at a minimum, the following: a. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls. b. Operation and maintenance manuals for each piece of lighting equipment and lighting controls with routine maintenance clearly identified including, as a minimum, a recommended relamping program and a schedule for inspecting and recalibrating all lighting controls. c. A complete narrative of how each lighting control systems is intended to operate including recommended settings.	The 2012 IECC does not include completion requirements for the lighting system other than the functional testing requirements in C408.3.

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SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS		
C406.1 Requirements. Buildings shall comply with at least one of the following: 1. Efficient HVAC Performance in accordance with Section C406.2. 2. Efficient Lighting System in accordance with Section C406.3. 3. On-Site Supply of Renewable Energy in accordance with Section C406.4. Individual tenant spaces shall comply with either Section C406.2 or Section C406.3 unless documentation can be provided that demonstrates compliance with Section C406.4 for the entire building	**No Comparable Provision**	Standard 90.1-10 does not have comparable Additional Efficiency Package Options.
C406.2 Efficient HVAC performance. Equipment shall meet the minimum efficiency requirements of Tables C406.2.(1) through C406.2(7) in addition to the requirements in Section C403. This section shall only be used where the equipment efficiencies in Tables C406.2(1) through C406.2(7) are greater than the equipment efficiencies listed in Table C403.2.3(1) through 403.2.3(7) for the equipment type.	**No Comparable Provision**	Standard 90.1-10 does not have comparable Additional Efficiency Package Options.
C406.3 Efficient lighting system. Whole building lighting power density (Watts/sf) shall comply with the requirements of Section C406.3.1.	**No Comparable Provision**	Standard 90.1-10 does not have comparable Additional Efficiency Package Options.
C406.3.1 Reduced lighting power density. The total interior lighting power (watts) of the building shall be determined by using the reduced whole building interior lighting power in Table C406.3 times the floor area for the building types.	**No Comparable Provision**	Standard 90.1-10 does not have comparable Additional Efficiency Package Options.
C406.4 On-site renewable energy. Total minimum ratings of on-site renewable energy systems shall comply with one of the following: 1. Provide not less than 1.75 Btu (1850 W), or not less than 0.50 watts per square foot (5.4 W/m2) of conditioned floor area. 2. Provide not less than 3 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in this	**No Comparable Provision**	Standard 90.1-10 does not have comparable Additional Efficiency Package Options.

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chapter.		
SECTION C408 SYSTEM COMMISSIONING		
C408.1 General. This section covers the commissioning of the building mechanical systems in Section C403 and electrical power and lighting systems in Section C405.		Standard 90.1-10 requires commissioning for HVAC systems for buildings greater than 50,000 ft^2. It is unclear if buildings less than this threshold require commissioning. No comparison was performed between the commissioning guidelines specific and the 2012 IECC.
C408.2 Mechanical systems commissioning and completion requirements. Prior to passing the final mechanical inspection, the *registered design professional* shall provide evidence of mechanical systems *commissioning* and completion in accordance the provisions of this section. Construction document notes shall clearly indicate provisions for *commissioning* and completion requirements in accordance with this section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner and made available to the *code official* upon request in accordance with Sections C408.2.4 and C408.2.5. **Exception:** The following systems are exempt from the commissioning requirements: 1. Mechanical systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h (140 690 W) cooling capacity and 600,000 Btu/h (175 860 W) heating capacity. 2. Systems included in Section C403.3 that serve dwelling units and sleeping units in hotels, motels, boarding houses or similar units.		See Above.
C408.2.1 Commissioning plan. A *commissioning plan* shall be developed by a *registered design professional* or approved *agency* and shall include the following items: 1. A narrative description of the activities that will be accomplished during each phase of commissioning, including the personnel intended to accomplish each of the activities. 2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be		See Above.

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performed. 3. Functions to be tested, including, but not limited to calibrations and economizer controls. 4. Conditions under which the test will be performed. At a minimum, testing shall affirm winter and summer design conditions and full outside air conditions. 5. Measurable criteria for performance.		
C408.2.2 Systems adjusting and balancing. HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within the tolerances provided in the product specifications. Test and balance activities shall include air system and hydronic system balancing.	**6.7.2.3 System Balancing** **6.7.2.3.1 General**. General. Construction documents shall require that all HVAC systems be balanced in accordance with generally accepted engineering standards (see Informative Appendix E). Construction documents shall require that a written balance report be provided to the building owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area exceeding 5000 ft2.	The provisions are similar.
C408.2.2.1 Air systems balancing. Each supply air outlet and *zone* terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp (0.74 kW), fan speed shall be adjusted to meet design flow conditions. **Exception:** Fans with fan motors of 1 hp (0.74 kW) or less.	**6.7.2.3.2 Air System Balancing.** Air systems shall be balanced in a manner to first minimize throttling losses. Then, for fans with fan system power greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.	The provisions are similar.
C408.2.2.2 Hydronic systems balancing. Individual hydronic heating and cooling coils shall be equipped with means for balancing and measuring flow. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the capability to measure pressure across the pump, or test ports at each side of each pump.	**6.7.2.3.3 Hydronic System Balancing**. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses; then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. **Exceptions:** Impellers need not to be trimmed nor pump speed adjusted a. For pumps with pump motors of 10 hp or less, or b. When throttling results in no greater than 5% of the nameplate horsepower draw, or 3 hp, whichever is greater, above that required if the impeller was trimmed.	The provisions in the 2012 IECC are more stringent than Standard 90.1-10 as the former requires pumps with motors greater than 5 hp to be balanced where as the later has a cut off of 10 hp.

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Exceptions: 1. Pumps with pump motors of 5 hp (3.7 kW) or less. 2. Where throttling results in no greater than five percent of the nameplate horsepower draw above that required if the impeller were trimmed.		
C408.2.3 Functional performance testing. Functional performance testing specified in Sections C408.2.3.1 through C408.2.3.3 shall be conducted.	**No Comparable Provision**	No comparable provision is included in Standard 90.1-10.
C408.2.3.1 Equipment. Equipment functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications such that operation, function, and maintenance serviceability for each of the commissioned systems is confirmed. Testing shall include all modes and *sequence of operation*, including under full-load, part-load and the following emergency conditions: 1. All modes as described in the *sequence* of *operation*; 2. Redundant or *automatic* back-up mode; 3. Performance of alarms; and 4. Mode of operation upon a loss of power and restoration of power. **Exception:** Unitary or packaged HVAC equipment listed in Tables C403.2.3(1) through C403.2.3(3) that do not require supply air economizers.	**No Comparable Provision**	No comparable provision is included in Standard 90.1-10.
C408.2.3.2 Controls. HVAC control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with *approved* plans and specifications.	**6.7.2.4 System Commissioning.** HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 ft2 conditioned area, except warehouses and semiheated spaces, detailed instructions for commissioning HVAC systems (see Informative Appendix E) shall be provided by the designer in plans and specifications.	The provisions are similar.
C408.2.3.3 Economizers. Air economizers shall undergo a functional test to determine that they operate in accordance with manufacturer's specifications.	**No Comparable Provision**	No comparable provision is included in Standard 90.1-10.
C408.2.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and certified by the *registered design professional* or *approved agency* and	**No Comparable Provision**	No comparable provision is included in Standard 90.1-10.

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provided to the building owner. The report shall be identified as "Preliminary Commissioning Report" and shall identify: 1. Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation. 2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions. 3. Climatic conditions required for performance of the deferred tests.		
C408.2.4.1 Acceptance of report. *Buildings*, or portions thereof, shall not pass the final mechanical inspection until such time as the *code official* has received a letter of transmittal from the *building* owner acknowledging that the *building* owner has received the Preliminary Commissioning Report.	**No Comparable Provision**	No comparable provision is included in Standard 90.1-10.
C408.2.4.2 Copy of report. The *code official* shall be permitted to require that a copy of the Preliminary Commissioning Report be made available for review by the *code official*.	**No Comparable Provision**	No comparable provision is included in Standard 90.1-10.
C408.2.5 Documentation requirements. The *construction documents* shall specify that the *documents* described in this section be provided to the *building* owner within 90 days of the date of receipt of the *certificate of occupancy*.	**No Comparable Provision**	No comparable provision is included in Standard 90.1-10.
C408.2.5.1 Drawings. Construction documents shall include the location and performance data on each piece of equipment.		Standard 90.1-10 has similar requirements in 6.7.2.1.
C408.2.5.2 Manuals. An operating and maintenance manual shall be provided and include all of the following: 1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance. 2. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified. 3. Name and address of at least one service agency. 4. HVAC controls system maintenance and calibration		Standard 90.1-10 has similar requirements in 6.7.2.2.

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information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in system programming instructions. 5. A narrative of how each system is intended to operate, including recommended setpoints.		
C408.2.5.3 System balancing report. A written report describing the activities and measurements completed in accordance with Section C408.2.2.	**6.7.2.3 System Balancing** **6.7.2.3.1 General**. General. Construction documents shall require that all HVAC systems be balanced in accordance with generally accepted engineering standards (see Informative Appendix E). Construction documents shall require that a written balance report be provided to the building owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area exceeding 5000 ft^2.	The 2012 IECC requires a system balancing report based on total building system size. Standard 90.1-10 uses conditioned area.
C408.2.5.4 Final commissioning report. A report of test procedures and results identified as "Final Commissioning Report" shall be delivered to the building owner and shall include: 1. Results of functional performance tests. 2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed. 3. Functional performance test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability. **Exception:** Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.	**6.7.2.4 System Commissioning.** HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 ft^2 conditioned area, except warehouses and semiheated spaces, detailed instructions for commissioning HVAC systems (see Informative Appendix E) shall be provided by the designer in plans and specifications.	Standard 90.1-10 requires commissioning for HVAC systems for buildings greater than 50,000 ft^2. It is unclear if buildings less than this threshold require commissioning. No comparison was performed between the commissioning guidelines specific and the 2012 IECC.
C408.3 Lighting system functional testing. Controls for automatic lighting systems shall comply with Section C408.3.	**9.4.4 Functional Testing**. Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions. When occupant sensor, time switches, and programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed: a. Confirm that the placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated	The provisions are similar.

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	and do not turn on unless space is occupied. b. Confirm that the time switches and programmable schedule controls are programmed to turn the lights off. c. Confirm that photosensor controls reduce electric light levels based on the amount of usable daylight in the space as specified. The construction documents shall state the party who will conduct and certify the functional testing. The party responsible for the functional testing shall not be directly involved in either the design or construction of the project and shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria. Certification shall be specific enough to verify conformance.	
C408.3.1 Functional testing. Testing shall ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the construction documents and manufacturer's installation instructions. The construction documents shall state the party who will conduct the required functional testing. Where required by the code official, an approved party independent from the design or construction of the project shall be responsible for the functional testing and shall provide documentation to the code official certifying that the installed lighting controls meet the provisions of Section C405. Where occupant sensors, time switches, programmable schedule controls, photosensors or daylighting controls are installed, the following procedures shall be performed: 1. Confirm that the placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance. 2. Confirm that the time switches and programmable schedule controls are programmed to turn the lights off. 3. Confirm that the placement and sensitivity adjustments for photosensor controls reduce electric light based on the amount of usable daylight in the space as specified.	**9.4.4 Functional Testing**. Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions. When occupant sensor, time switches, and programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed: a. Confirm that the placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied. b. Confirm that the time switches and programmable schedule controls are programmed to turn the lights off. c. Confirm that photosensor controls reduce electric light levels based on the amount of usable daylight in the space as specified. The construction documents shall state the party who will conduct and certify the functional testing. The party responsible for the functional testing shall not be directly involved in either the design or construction of the project and shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria. Certification shall be specific enough to verify conformance.	The provisions are similar

The U.S. Department of Energy's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.

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