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Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings

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Prepared by Pacific Northwest National Laboratory
for the U.S. Department of Energy Building Energy Codes Program

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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

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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 2009 International Energy Conservation Code® (IECC) as applied to commercial buildings and ANSI/ASHRAE/IESNA[1] Standard 90.1-2007 (hereinafter referred to as Standard 90.1-07). 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 2009 IECC and Standard 90.1-07.

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 90.1-07. 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. This report compares the 2009 IECC to Standard 90.1-07 with the intent of helping states address whether the adoption and application of the 2009 IECC for commercial buildings can be considered equivalent to the adoption and application of Standard 90.1-07. Based on this document, states adopting the 2009 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."

[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 90.1-07 and the 2009 IECC as applied to commercial buildings.

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 2009 IECC or Standard 90.1-07) 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 2009 IECC and Standard 90.1-07 are listed below. Because no energy analysis to quantify the magnitude of any difference in annual energy use of 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).

- Standard 90.1-07 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 2009 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 90.1-07 generally have more rigorous thermal envelope requirements under the 2009 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.
- The 2009 IECC considers sloped glazing within 15 to 30 degrees of horizontal to be part of the wall and subject to the vertical fenestration provisions of the code, which are generally more rigorous than the provisions for skylights (glazing less than 15 degrees from vertical). Standard 90.1-07 considers glazing 30 degrees or less from vertical as skylights. While the skylight and vertical fenestration provisions are generally identical between the documents, the difference in what constitutes a skylight means glazing in the 15 to 30-degree range under Standard 90.1-07 would be considered skylights rather than vertical fenestration and, as such, could have lesser thermal requirements than under the 2009 IECC for vertical fenestration.
- The aforementioned difference in tilt angle defining the transition between a skylight and vertical fenestration means that a building evaluated to the 2009 IECC could reach the 40% (maximum) Window-to-Wall-Ratio (WWR) limitation in Chapter 5 with less overall glazing area than one evaluated under Standard 90.1-07. Adding glazing beyond the 40% limit imposes a requirement for buildings under the 2009 IECC to meet Standard 90.1-07 and in those cases eliminates any basis for difference between the 2009 IECC and Standard 90.1-07. Interestingly, it is possible that a building with a WWR of just over 40%, pursuant to the 2009 IECC, would have to be evaluated under Standard 90.1-07, as referenced in the 2009 IECC, and then found under Standard 90.1-07 to have a WWR of less than 40% and hence allowed to use provisions in Standard 90.1-07 that are essentially paralleled in the 2009 IECC and the subject of this comparison. This situation may cause some confusion but should have nominal impact because the buildings where the WWR situation, described above, would occur is assumed to be minimal.
- Standard 90.1-07 has different provisions for above- and below-grade walls, the latter being generally less stringent. The 2009 IECC is the same in this regard, and the provisions in both documents are

essentially the same, except that under Standard 90.1-07, 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 2009 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 2009 IECC, that document may be more stringent on average.

- Both Standard 90.1-07 and the 2009 IECC have maximum WWRs of 40%; however, the 2009 IECC defines the WWR with respect to above-grade wall area, while Standard 90.1-07 uses the gross wall area, which includes below-grade walls. Therefore, a building with below-grade walls is effectively allowed a higher vertical fenestration area under Standard 90.1-07 compared to the 2009 IECC before the envelope tradeoff option in Section 5.6 of Standard 90.1-07 must be used.
- The thermal requirements for opaque and non-opaque assemblies are not always identical between the two documents, although the climate zones are identical. In some instances Standard 90.1-07 is more stringent and in others the 2009 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 90.1-07 and commercial under the 2009 IECC. Thus, in some instances, a building built to the 2009 IECC would have less rigorous thermal envelope provisions than if built to ASHRAE Standard 90.1-07.
- Standard 90.1-07 allows for an increase in the allowable maximum U-factor (reduction in required R-value) for certain roof/ceiling assemblies if the roof meets certain reflectance and emissivity requirements. This allowance is not provided in the 2009 IECC. *States in climate zones 1 to 3 MAY want to conduct additional analysis for affected roof/ceiling assemblies to determine the difference in energy use between a roof/ceiling with more insulation under the 2009 IECC or the same roof/ceiling with less insulation but specific reflectance and emissivity properties on the roof deck.*
- In some cases the allowable damper leakage rates in Standard 90.1-07 are higher than those in the 2009 IECC. Thus, in some cases, the 2009 IECC is more stringent.
- The 2009 IECC limits Heating, Ventilating and Air-Conditioning (HVAC) equipment oversizing and Standard 90.1-07 does not. Thus, in some cases, the 2009 IECC would result in equipment that operates more efficiently on a seasonal basis.
- Standard 90.1-07 requires the delivery of Operation and Maintenance (O&M) manuals for the building systems and the 2009 IECC does not. Thus, the 2009 IECC may result in buildings that are not operated as efficiently by the initial occupants.
- There are several subtle differences between the documents related to HVAC equipment and systems that could have an impact in the aggregate. Standard 90.1-07 tends to be more rigorous and, in some cases (e.g., fume hoods, cooling towers, dehumidification, and kitchen exhaust hoods), has

requirements that are not in the 2009 IECC. It should be noted, however, that while the 2009 IECC−as one of a series of codes−may not have certain provisions, those provisions may be located elsewhere (e.g., within other codes, such as the International Mechanical Code).

- The prescriptive lighting power limits are the same in both documents for all building types. However, Standard 90.1-07 contains 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. There are also subtle differences between the two documents with respect to lighting controls and certain exceptions. In addition, some provisions, such as voltage drop limitations in Standard 90.1-07, are not covered in the 2009 IECC, but as with the mechanical code noted above, that issue is addressed in other codes (e.g., the National Electrical Code [NEC]). For the most part, it is difficult to generalize whether these subtleties favor one document or the other.

Detailed Comparison

The following table provides the requirements from the 2009 IECC in the first column and the comparable provisions from Standard 90.1-07 in the second. The third column, labeled "Comparative Notes," provides commentary on the comparability of the subject provisions from both documents.

2009 IECC	Standard 90.1-07	Comparative Notes
501.1 Scope. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings. These commercial buildings shall meet either the requirements of ASHRAE/IESNA Standard 90.1, *Energy Standard for Buildings Except for Low-Rise Residential Buildings*, or the requirements contained in this chapter.	**5.1.1 Scope.** Section 5 specifies requirements for the building envelope.	The 2009 IECC says meet what is in the 2009 IECC OR meet Standard 90.1-07. If the scope of Chapter 5 of the 2009 IECC and Standard 90.1-07 are the same, then these provisions, which set up either meeting Chapter 5 or Standard 90.1-07, are equal. A review of the scope of both documents finds they both apply to buildings; it is a specific term with a specific definition.
501.2 Application. The *commercial building* project shall comply with the requirements in Sections 502 (Building envelope requirements), 503 (Building mechanical systems), 504 (Service water heating) and 505 (Electrical power and lighting systems) in its entirety. As an alternative the *commercial building* project shall comply with the requirements of ASHRAE/IESNA 90.1 in its entirety.		Meet either all of Chapter 5 of the 2009 IECC OR Standard 90.1-07. Again, this is scope only, so if the scope of Chapter 5 and Standard 90.1-07 are the same, then they are equivalent.
Exception: Buildings conforming to Section 506, provided Sections 502.4, 503.2, 504, 505.2, 505.3, 505.4, 505.6 and 505.7 are each satisfied.		The closest correlation in Standard 90.1-07 is Chapter 11 - Energy Cost Budget Method. Both of these allow for performance alternatives. The 2009 IECC simply states that you have to follow the mandatory requirements if you use the whole-

2009 IECC	Standard 90.1-07	Comparative Notes
		building tradeoff; which is identical to Standard 90.1-07. Assuming the scope of both is the same and the methodologies for doing the comparison of baseline and as-built buildings are the same, then the 2009 IECC and Standard 90.1-07 would be the same as long as the baseline requirements in both documents are the same.
DEFINITIONS		A comparison of relevant definitions occurs throughout this document as relevant to the issue being compared.
DESIGN CONDITIONS Chapter 3	**5.1.4**	The climate zones appear to be the same between the 2009 IECC and Standard 90.1-07 and, as such, all else being the same, the criteria would be the same between Chapter 5 of the 2009 IECC and Standard 90.1-07.
Administrative Requirements Chapter 1	**Compliance Chapter 4**	There are some subtle differences. One is the lack of requirements in the 2009 IECC for O&M manuals.
SECTION 502 BUILDING ENVELOPE REQUIREMENTS		
502.1 General (Prescriptive).		
502.1.1 Insulation and fenestration criteria. The *building thermal envelope* shall meet the requirements of Tables 502.2(1) and 502.3 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 502.2(1). 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 502.2(1). Buildings with a vertical fenestration area or skylight area that exceeds that allowed in Table 502.3 shall comply with the building envelope provisions of 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 Tables 5.5-1 through 5.5-8 for the appropriate climate. **5.5.2** If a building contains any *semi-heated space* or *unconditioned space*, then the *semi-exterior building envelope* shall comply with the requirements for *semi-heated space* in Tables 5.5-1 through 5.5-8 for the appropriate climate (See Figure 5.5.)**.** **5.7.2 Submittal Document Labeling of Space Conditioning Categories.** For buildings that contain spaces that will be only semi-heated or unconditioned, and compliance is sought using the "semi-heated" envelope criteria, such spaces shall be clearly indicated on the floor plans that are	If a building is greater than 40% WWR or greater than 3% skylights as a percentage of roof area, then in referencing Standard 90.1-07 the 2009 IECC is equal to Standard 90.1-07 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 90.1-07, for the purposes of determining the percentage of wall that is vertical fenestration, aside from the skylight difference, Standard 90.1-07 uses "walls" as the denominator; they are defined as both above- and below-grade walls. Chapter 5 of the 2009 IECC, in

2009 IECC	Standard 90.1-07	Comparative Notes
	submitted for review.	addressing the WWR, considers only above-grade walls. This means that a building under the 2009 IECC is more likely to reach the 40% WWR limitation, especially when considering the skylight definition, faster than a similar building under Standard 90.1-07. 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 90.1-07. Ironically, some buildings just over the 40% limitation, according to Chapter 5, would then be subject to the prescriptive provisions of Standard 90.1-07 as opposed to the performance provisions for the envelope. Regarding Section 5.7.2 in Standard 90.1-07, the existence of a parallel provision in the 2009 IECC is moot because the 2009 IECC treats heated and semi-heated spaces the same (as heated spaces). As discussed above, the difference in how skylights are addressed will impact the comparable stringency of the documents This difference in definition means that glazing is more likely to be considered vertical fenestration under the 2009 IECC than Standard 90.1-07.
502.1.2 *U*-factor alternative. An assembly with a *U*-factor, *C*-factor, or *F*-factor equal or less than that specified in Table 502.1.2 shall be permitted as an alternative to the *R*-value in Table 502.2(1). 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 502.1.2. 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 502.1.2.	**5.5.3 Opaque Areas** For all opaque surfaces except doors, compliance shall be demonstrated by one of the following two methods: 1. Minimum *rated R-values of insulation* for the thermal resistance of the added insulation in framing cavities and *continuous insulation* only. Specifications listed in Normative Appendix A for each *class of construction* shall be used to determine compliance. 2. 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.	The 2009 IECC prescriptive provisions and performance alternatives appear to be mirrored in Standard 90.1-07 with the exception that the required or maximum/minimum values between the two documents are different. 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 5 of the 2009 IECC and Standard 90.1-07, the two

2009 IECC	Standard 90.1-07	Comparative Notes
	Exceptions: 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 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*.	documents result in different minimum acceptable designs under the alternative approaches to compliance. Based on a cursory review related to the skylight/vertical fenestration issue, the above- and below-grade walls issue, and the differences in thermal requirements, it is more probable that a building meeting the overall approach per Chapter 5 of the 2009 IECC would have a lower heating and cooling load associated with the building envelope (not considering infiltration) than if the same building were to just meet Standard 90.1-07 requirements.
303.1.1 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. **303.1.1.1 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	**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. 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. **5.8.1.3 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.	The provisions in Standard 90.1-07 are a little more detailed than those in the 2009 IECC, but for all intents and purposes, because both documents refer back to the manufacturer's instructions, they could be considered comparable.

2009 IECC	Standard 90.1-07	Comparative Notes
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. **303.1.2 Insulation Mark Installation.** Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection.	**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. **5.8.1.5 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. **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. **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. **5.8.1.9 Extent of Insulation.** Insulation shall extend over the full component area to the required rated R-value of insulation, U-factor, C-factor, or F-factor, unless otherwise allowed in Section 5.8.1.	
502.2 Specific Insulation Requirements (Prescriptive). Opaque assemblies shall comply with Table 502.2(1).		A comparison of the thermal envelope provisions finds that Standard 90.1-07 differs from Chapter 5 of the 2009 IECC as follows: In climate zone 1, metal walls above grade are less stringent in Standard

2009 IECC	Standard 90.1-07	Comparative Notes
		90.1-07 and there are no steel joist criteria in the 2009 IECC, such that metal floors must meet significantly more stringent criteria. Standard 90.1-07 has less stringent criteria for roofs and walls for semi-heated spaces. Metal framing vertical glazing has a lower U-factor in the 2009 IECC. Skylight U-factors are less stringent in Standard 90.1-07 but the solar heat gain coefficient (SHGC) provisions in Standard 90.1-07 are equal or more stringent than the 2009 IECC. Semi-heated spaces in 90.1-07 require less insulation in some envelope components and no SHGC and, as noted above, the 2009 IECC would treat such spaces as heated spaces. In climate zone 2, many components in the semi-heated classification in Standard 90.-071, including fenestration criteria, are less stringent than the provisions in Chapter 5 of the 2009 IECC. Metal building roofs and walls above grade are more stringent in the 2009 IECC than in Standard 90.1-07. Requirements for wood-framed floors are a little more stringent in the 2009 IECC for nonresidential and considerably more for residential. Vertical fenestration is the same, but for skylights the 2009 IECC is always more stringent and for SHGC Standard 90.1-07 is generally always more stringent. There is also an apparent error in the 2009 IECC because values for floor joist/framing are inconsistent. Climate zone 3 has differences similar to those described above for climate zone 2, but the degree of difference between the numbers is not generally as much. Climate zone 4 is much the same as zones 2 and 3. The issue with semi-heated space remains. Metal building roofs are more stringent in the 2009 IECC, as are metal building above-grade walls. Fenestration is

2009 IECC	Standard 90.1-07	Comparative Notes
		the same, but skylight U-factors and SHGC are generally more stringent in the 2009 IECC. Climate zone 5 is much the same as zone 4. There are obvious discrepancies between the two tables in the 2009 IECC that need to be fixed and some apparent ones in Standard 90.1-07 as well. Aside from the semi-heated space issue, the documents differ on metal building roofs and walls above grade; the 2009 IECC is more stringent on residential swinging doors. Also, the 2009 IECC does not distinguish between floor joist/framing materials, while Standard 90.1-07 has separate provisions for steel joists that make Standard 90.1-07slightly less stringent than the 2009 IECC for steel floor framing. Fenestration is the same for vertical glazing between the documents other than for semi-heated spaces, whereas Standard 90.1-07 has higher minimums. Also, the SHGC is unregulated in semi-heated spaces and varies with PF, as discussed below. The skylight U-factor is always lower in the 2009 IECC and in most cases the SHGC is as well. Climate zone 6 has about the same issues as zone 5. There are some errors in both the 2009 IECC and Standard 90.1-07 where there are inconsistencies that do not make sense within the tables in each document. Climate zone 7 has about the same issues as zone 6. The roof insulation for insulation above deck is considerably more restrictive in Standard 90.1-07 compared to the 2009 IECC. There are also some anomalies that suggest there are errors in the 2009 IECC. The U-factor for all skylights is, in many cases, significantly less stringent in Standard 90.1-07 but is never more stringent than the 2009 IECC. There

2009 IECC	Standard 90.1-07	Comparative Notes
		are no SHGC criteria for skylights in the 2009 IECC, but there are for heated and cooled buildings and spaces in Standard 90.1-07. Climate zone 8 has about the same issues as zone 7. All the roof requirements in Standard 90.1-07 are less stringent than the 2009 IECC except Standard 90.1-07 is more stringent for attic and other types of spaces. There are some anomalies in the tables, which suggest possible editing errors. Windows in residential buildings have no SHGC in Standard 90.1-07 but do in the IECC for up to 0.25 Projection Factor (PF). There is also a subtle difference associated with the opaque thermal requirements. Section 502.1.1 of the 2009 IECC refers the residential provisions to Use Group R buildings, which is a defined term in the International Building Code (IBC). Standard 90.1-07 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 2009 IECC, but as defined in Standard 90.1-07, the envelope associated with the patient rooms would have to meet the more stringent residential provisions of the envelope tables.
502.2.1 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	**5.5.31. Roof Insulation.** All *roofs* shall comply with the insulation values specified in Tables 5.5-1 through 5.5-8 or shall comply with the insulation values specified in Section 5.5.3.1.1 and Table 5.5.3.1.	Skylights are defined differently in the 2009 IECC and Standard 90.1-07. Glazing in the 2009 IECC from 75 to 60 degrees within horizontal is considered vertical fenestration, while in Standard 90.1-07 such

2009 IECC	Standard 90.1-07	Comparative Notes
Table 502.2(1), 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.	glazing is considered skylights. Any glazing considered vertical fenestration instead of skylights would generally have more stringent provisions in the 2009 IECC as compared to Standard 90.1-07, based on a comparison of the thermal requirements for vertical glazing in both documents. For instance, in climate zone 1 the U-factor could rise from 1.2 to 1.36 and the SHGC from 0.25 to 0.36 between the 2009 IECC and Standard 90.1-07 by considering s vertical fenestration as skylights. There does not appear to be a criterion in the 2009 IECC associated with insulation of skylight curbs, while there is in Standard 90.1-07. The definition of "skylight" in the 2009 IECC and the definition of "roof assembly" suggests that the skylight curbs and related opaque materials associated with the skylight installation, but not the skylight itself, are covered as part of the roof and must meet the applicable insulation requirements for the roof. See above for discussion on opaque insulation requirements for roofs between the 2009 IECC and Standard 90.1-07. For the most part, both documents are the same except Standard 90.1-07 allows a reduction in stringency for semi-heated buildings or spaces and the U-factors for metal buildings are generally a little lower in the 2009 IECC as compared to Standard 90.1-07.
Exception: 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 502.2(1). Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.	**5.8.1.8 Location of Roof Insulation.** The *roof* insulation shall not be installed on a suspended ceiling with removable ceiling panels.	The documents seem to be equivalent with respect to not allowing insulation on suspended ceilings to count toward compliance, although the 2009 IECC says it cannot be counted and Standard 90.1-07 says it cannot be installed on the panels.

2009 IECC	Standard 90.1-07	Comparative Notes
No corresponding section	**5.5.3.1.1 High Albedo Roofs.** For roofs other than ventilation attics or roofs over semi-heated spaces or roofs over conditioned spaces that are not cooled spaces, where the exterior surface has: a. a solar reflectance of 0.70 when tested in accordance with ASTM C1549, ASTM E903, or ASTM E1918 and, in addition, a minimum thermal emittance of 0.75 when tested in accordance with ASTM C1371 or ASTM E408 or b. a minimum Solar Reflectance Index of 82 when determined in accordance with the Solar Reflectance Index method in ASTM E1980, the insulation value for the roof shall comply with the values in Table 5.5.3.1. The values for solar reflectance and thermal emittance shall be determined by a laboratory accredited by a Cool Roof Rating Council CRRC-1 Product rating Program, and shall be labeled and certified by the manufacturer.	The existence of such a provision in Standard 90.1-07 and the lack of one in the 2009 IECC would suggest that under the latter any materials could be used with respect to solar reflectance, Solar Reflective Index, thermal emittance, etc. and, as such, the 2009 IECC is not as rigorous as Standard 90.1-07.
502.2.2 Classification of walls. Walls associated with the building envelope shall be classified in accordance with Section 502.2.2.1 or 502.2.2.2.		
502.2.2.1 Above-grade walls. Above-grade walls are those walls covered by Section 502.2.3 on the exterior of the building and completely above grade or walls that are more than 15 % above grade.	**Chapter 2 definition of above-grade wall:** a wall that is not a below-grade wall.	
502.2.2.2 Below-grade walls. Below-grade walls covered by Section 502.2.4 are basement or first-story walls associated with the exterior of the building that are at least 85 percent below grade.	**Chapter 2 definition of below-grade wall:** that 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 2009 IECC and 90.1-07. 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 90.1-07 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

2009 IECC	Standard 90.1-07	Comparative Notes
		the purpose of determining WWR indicates that under the 2009 IECC the WWR is based on above-grade wall area and in Standard 90.-07 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.
502.2.3 Above-grade walls. The minimum thermal resistance (*R*-value) of the insulating material(s) installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Table 502.2(1), based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units (CMU) shall not be used in determining compliance with Table 502.2(1). "Mass walls" shall include walls weighing at least (1) 35 pounds per square foot (170 kg/m2) of wall surface area or (2) 25 pounds per square foot (120 kg/m2) of wall surface area if the material weight is not more than 120 pounds per cubic foot (1900 kg/m3).	**5.5.3.2 Above Grade Wall Insulation.** All *above grade walls* shall comply with the insulation values specified in Tables 5.5 1 through 5.5 8. When a *wall* consists of both *above grade* and *below grade* portions, the entire *wall* for that story shall be insulated on either the exterior or the interior or be integral. a. If insulated on the interior, the *wall* shall be insulated to the *above grade wall* requirements. b. If insulated on the exterior or integral, the *below grade wall* portion shall be insulated to the *below grade wall* requirements, and the *above grade wall* portion shall be insulated to the *above grade wall* requirements.	One would need to compare the required insulation values in each document. The item above regarding above- and below-grade walls would apply here. There are conditions where a wall that is 85% below grade or more could be considered entirely below grade in the 2009 IECC and the above-grade portion possibly insulated less under the 2009 IECC than Standard 90.1-07. The insulation requirements for above-grade walls are generally more stringent than those for below-grade walls in both documents. This means that a wall that is 85% below grade could have the remaining 15% above grade; under the 2009 IECC that above-grade portion would be insulated to the below grade (lower provisions) while in Standard 90.1-07 that same wall would have to meet the above-grade provisions if the insulation were on other than the interior of the wall and if on the interior, then the entire wall would have to be insulated to the more stringent above-grade criteria. On this issue Standard 90.1-07 is clearly more stringent than the 2009 IECC.
502.2.4 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 502.2(1), and shall extend to a depth of 10 feet (3048 mm) below the outside finished	**5.5.3.3 Below Grade Wall Insulation.** *Below grade walls* shall have a *rated R value of insulation* not less that the insulation values specified in Tables 5.5 1 through 5.5 8. **Exception**: Where framing,	See above.

2009 IECC	Standard 90.1-07	Comparative Notes
ground level, or to the level of the floor, whichever is less.	including metal and wood studs, is used, compliance shall be based on the maximum assembly *C-factor*.	
502.2.5 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 502.2(1), based on construction materials used in the floor assembly. "Mass floors" shall include floors weighing at least (1) 35 pounds per square foot (170 kg/m^2) of floor surface area or (2) 25 pounds per square foot (120 kg/m^2) of floor surface area if the material weight is not more than 12 pounds per cubic foot (1,900 kg/m^3).	**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 2009 IECC, so it is not clear what would constitute a wall or floor if certain exterior envelope components were not vertical or horizontal. Standard 90.1-07 defines floors as surfaces associated with the thermal envelope that are less than 60 degrees from vertical. As such, it is possible in Standard 90.1-07 to have some surfaces that would likely be called floors, which under the 2009 IECC would be considered walls and therefore subject to less stringent requirements. Also, mass floors are defined in Standard 90.1-07 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.
502.2.6 Slabs on grade. 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 502.2(1). The insulation shall be placed on the outside of the foundation or on the inside of a 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.	**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 90.1-07 defines slabs on grade as those above grade or below grade within 24 inches of finished grade. Appendix A of Standard 90.1-07 also provides details for the installation of the insulation which, to some degree, parallel the provisions in the 2009 IECC. The 2009 IECC does not define slabs on grade. Clearly, the documents would be identical with respect to slabs with the top of the slab at grade. Due to the lack of definition in the 2009 IECC, it is not likely that users would consider a slab with the floor surface 24 inches below grade a slab on grade. As such, it is reasonable to assume that some slabs required to be insulated per Standard 90.1-07 would be uninsulated per the 2009 IECC. This would not be an issue in warmer climate zones for unheated slabs where there are no insulation requirements.
502.2.7 Opaque doors. Opaque	**5.3.3.6 Opaque Doors.** All *opaque*	Under the 2009 IECC, doors that are

2009 IECC	Standard 90.1-07	Comparative Notes
doors (doors having less than 50 percent glass area) shall meet the applicable requirements for doors as specified in Table 502.2(1) and be considered as part of the gross area of above-grade walls that are part of the building envelope.	*doors* shall have a *U-factor* not greater than that specified in Tables 5.5-1 through 5.5-8. Also the definition of fenestration area provides that where glazing is less than 50% of door area then the fenestration area is the glazed area of the door.	less than 50% glass are opaque doors. The door provisions in Standard 90.1-07 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 2009 IECC, but in Standard 90.1-07 it is unclear if they are also considered all opaque or they must meet the respective provisions for the opaque and fenestration portions of the door.
502.3 Fenestration (Prescriptive). Fenestration shall comply with Table 502.3.		
502.3.1 Maximum area. The vertical fenestration area (not including opaque doors) shall not exceed the percentage of the gross wall area specified in Table 502.3. The skylight area shall not exceed the percentage of the gross roof area specified in Table 502.3.	**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 (b) to Section 5.5.4.4.1. **5.5.4.2.2 Skylight Fenestration Area.** The total *skylight area* shall be less than 5% of the *gross roof area*.	One would need to look at definitions of fenestration. The percentages for walls at 40% WWR are the same in both documents and beyond 40% WWR Standard 90.1-07 is the only document that applies so a comparison beyond 40% WWR would show the envelope provisions are the same in both documents in that the user must use Standard 90.1-07 in all cases. The skylight limitation in Standard 90.1-07 is 5% and in the 2009 IECC is 3%, so areas from just over 3% to inclusive of 5% in the 2009 IECC would mean the envelope would have to meet Standard 90.1-07 requirements. That would not appear to be an issue except to the degree that Standard 90.1-07 would have different requirements for fenestration than the 2009 IECC. As noted above, the skylight provisions are significantly different between the 2009 IECC and Standard 90.1-07. In addition, the difference in definitions of skylights between the 2009 IECC and Standard 90.1-07 (75 to 60 degrees from horizontal) means that, in some instances, a particular building that might fall under the 40% WWR in the 2009 IECC would not meet Standard 90.1-07 requirements and, similarly, one that might fall under the skylight

2009 IECC	Standard 90.1-07	Comparative Notes
		percentage per Standard 90.1-07 might not in the 2009 IECC.
502.3.2Maximum*U*-factor and SHGC. For vertical fenestration, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3, based on the window projection factor. For skylights, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3. The window projection factor shall be determined in accordance with Equation 5-1. *PF* = *A/B* **(Equation 5-1)** 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, or an area-weighted *PF* value shall be calculated and used for all windows and glass doors.	**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*. **5.5.4.4.1 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 on 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 O_s, which is derived as follows: $O_s = (A_i \cdot O_i) + (A_f \cdot O_f)$ 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 $O_i = (100\% - T_s)$, where T_s is the solar	A comparison of the 2009 IECC and Standard 90.1-07 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 90.1-07, such spaces would be considered conditioned by the 2009 IECC and, as such, there are climate zones in which the glazing provisions would be more stringent in the 2009 IECC because there is no distinction between conditioned and semi-heated space. Another factor to consider is that the 2009 IECC considers skylights as being less than 75 degrees from horizontal (>=15 from vertical), while Standard 90.1-07 considers skylights less than 60 degrees from horizontal. This means that glazing between 60 degrees to just below 75 degrees from horizontal is vertical fenestration in the 2009 IECC and skylight in Standard 90.1-07. Depending on the climate zone, one document or the other would be more stringent. A quick comparison of vertical fenestration criteria finds that the 2009 IECC and Standard 90.1-07 have the same requirements for U-factor except the latter has less stringent requirements for semi-heated spaces. Also in climate zone 1, the former has a 1.0 U-factor requirement for curtain walls while the latter has a requirement of 1.2. The latter has SHGC criteria for vertical fenestration that are consistent with the former for a PF of <0.25. The former allows SHGC to increase based on PF and the latter provides a table of multipliers, by orientation and PF, which allows

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	transmittance as determined in accordance with NFRC 300; for perforated or decorative metal panels O_i = percentage of solid material 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*.	the SHGC of the proposed glazing to be reduced for the purpose of compliance. This is counter-intuitive because in a code one would expect the maximum allowable criterion to float up in this case, based on PF as opposed to maintaining the legal maximum the same and allowing the designer to "adjust" the SHGC of their fenestration product "down." For instance, in climate zone 1 the 2009 IECC allows an increase from SHGC 0.25 to 0.40 for a PF greater than or equal to 0.50. In the same climate zone, Standard 90.1-07 would require 0.25 but would allow multipliers to the actual glass selected from 0.61 to 0.47 at 10% PF increments. This means that a 0.40 SHGC for 50% to 60% PF would comply with the 0.25 because 0.61 x 0.40 greater than or equal to 0.25. A review of this over the range of 2009 IECC conditions and Standard 90.1-07 multipliers shows the effective SHGC limitations in Standard 90.1-07 result in it being equal to or less stringent than the 2009 IECC for situations where the PF is <0.25. For climate zones 1 to 3, Standard 90.1-07 is generally less stringent than the 2009 IECC, except from PF =0.25 to <=0.30 and at PF = 0.50. For other climate zones where SHGC is unregulated, Standard 90.1-07 would then be more stringent, requiring SHGCs of 0.49 to 0.85 in climate zones 4 to 6 as PF increased and 0.55 to 0.96 in climate zones 7 and 8. In summary, if the PF is less than 0.25 or in all cases in climate zones 1 to 3, then the 2009 IECC is generally a little more stringent than Standard 90.1-07, and in all other situations Standard 90.1-07 is more stringent (the 2009 IECC has no criteria). The 2009 IECC has very simplified provisions for skylight U-factor and SHGC. In most cases the 2009 IECC appears to have more stringent (lower) U-factor and SHGC requirements than Standard 90.1-07.

2009 IECC	Standard 90.1-07	Comparative Notes
	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*.	The 2009 IECC does not contain or mention the term Visible Light Transmittance (VLT). While Standard 90.1-07 does, as noted in Section 5.8.2.6, it is unclear if there are actually any provisions in Standard 90.1-07 regulating VLT. A review of the 2009 IECC did not find any. On that basis the 2009 IECC and Standard 90.1-07 could be considered equal because the latter, while mentioning the term, has no applicable requirements.
502.3.2Maximum *U*-factor and SHGC. For vertical fenestration, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3, based on the window projection factor. For skylights, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3. The window projection factor shall be determined in accordance with Equation 5-1. *PF = A/B* **(Equation 5-1)** 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, or an area-weighted *PF* value shall be calculated and used for all windows and glass doors.	**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. **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*.	It appears that the 2009 IECC allows for a tradeoff based on area-weighted PFs but does not allow tradeoffs based on U-factor or SHGC. This is a convenience for the user and as a tradeoff alternative would not appear to impact the stringency of one document over the other.
303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and	**5.8.2.1 Rating of Fenestration Products.** The U-factor, SHGC, and air leakage rate for all	The 2009 IECC and Standard 90.1-07 appear to be comparable with respect to fenestration testing and

2009 IECC	Standard 90.1-07	Comparative Notes
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 303.1.3(1) or 303.1.3(2). The solar heat gain coefficient (SHGC) 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 shall be assigned a default SHGC from Table 303.1.3(3).	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, and air leakage rate. **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. **5.8.2.4 U-factor.** U-factors shall be determined in accordance with NFRC 100. U-factors for skylights shall be determined for a slope of 20 degrees above the horizontal. **Exceptions:** a. U-factors from Section A8.1 shall be an acceptable alternative for determining compliance with the U-factor 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 an 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*.	labeling. It does appear, however, that Standard 90.1-07 allows for a credit for low-emissivity coatings on skylights that is not readily apparent in the 2009 IECC. There is no parallel provision in the 2009 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 90.1-07 requires a permanent nameplate with the door U-factor while the 2009 IECC does not (but it does for fenestration).

2009 IECC	Standard 90.1-07	Comparative Notes
	5.8.2.5 Solar Heat Gain Coefficient. *SHGC* for the overall *fenestration area* shall be determined in accordance with NFRC 200. 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 using a spectral data file determined in accordance with 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 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 alternative for determining compliance with the *SHGC* criteria for *vertical fenestration*. **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.	

2009 IECC	Standard 90.1-07	Comparative Notes
	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.	
502.4 Air leakage (Mandatory).		
502.4.1 Window and door assemblies. The air leakage of window and sliding or swinging door assemblies that are part of the building envelope shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or NFRC 400 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer and shall not exceed the values in Section 402.4.2. (Actually, it is Section 402.4.4. The provisions therein are 0.3 cfm per sq. ft. for windows, skylights and sliding glass doors and 0.5 cfm per sq. ft. for swinging doors.	**5.4.3.2 Fenestration and Doors.** Air leakage for *fenestration* and *doors* shall be determined in accordance with NFRC 400. 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 1.0 cfm/ft^2 for glazed swinging entrance doors and for revolving doors and 0.4 cfm/ft^2 for all other products.	The 2009 IECC has no requirements to limit skylight infiltration. Although Section 402.4.4 of the 2009 IECC provides them, the scope of Section 502.4.1of the 2009 IECC does not include skylights. The definition of fenestration in Standard 90.1-07 includes skylights. Comparing the documents indicates that the 2009 IECC references additional test standards, more than Standard 90.1-07, and has more stringent provisions for windows, sliding doors, and swinging doors. For skylights, Standard 90.1-07 is clearly more stringent. Note also that the definition difference associated with vertical fenestration and skylights between the two documents would have to be considered in comparing the infiltration requirements.
Exception: Site-constructed windows and doors that are weatherstripped or sealed in accordance with Section 502.4.3.	a. Field-fabricated fenestration and doors. b. For garage *doors*, air leakage determined by test at standard test conditions in accordance with ANSI/DASMA 105 shall be an acceptable alternate for compliance with air leakage requirements.	
502.4.2 Curtain wall, storefront glazing and commercial entrance doors. Curtain wall, *storefront* glazing and commercial-glazed	***(It would appear there are no requirements in 90.1-07 on this issue. The definition of fenestration in 90.1-07 would***	See above.

2009 IECC	Standard 90.1-07	Comparative Notes
swinging entrance doors and revolving doors shall be tested for air leakage at 1.57 pounds per square foot (psf) (75 Pa) in accordance with ASTM E 283. For curtain walls and *storefront* glazing, the maximum air leakage rate shall be 0.3 cubic foot per minute per square foot (cfm/ft2) (5.5 m3/h × m2) of fenestration area. For commercial glazed swinging entrance doors and revolving doors, the maximum air leakage rate shall be 1.00 cfm/ft2 (18.3 m3/h × m2) of door area when tested in accordance with ASTM E 283.	***appear to include these envelope components as well.)***	
502.4.3 Sealing of the building envelope. Openings and penetrations in the building envelope shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.	**5.4.3.1 Building Envelope Sealing.** The following areas of the *building envelope* shall be sealed, caulked, gasketed, or weather-stripped to minimize air leakage: a. joints around *fenestration* and *door* frames b. junctions between *walls* and foundations, between *walls* at building corners, between *walls* and structural *floors* or *roofs*, and between *walls* and *roof* or *wall* panels c. openings at penetrations of utility services through *roofs*, *walls*, and *floors* d. site-built *fenestration* and *doors* e. building assemblies used as ducts or plenums f. joints, seams, and penetrations of vapor retarders g. all other openings in the *building envelope*	A comparison of the text suggests that they are comparable but not identical.
502.4.4 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 502.4.4.	**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.	This 2009 IECC provision does not belong in the envelope section, but the text is identical to the corresponding Standard 90.1-07 provision.
Exception: Unitary packaged systems with cooling capacities not greater than 90,000 Btu/h (26 379 W).	**Exception to 6.5.9.** Unitary packaged systems with cooling capacities not greater than 90,000 Btu/h.	The provisions are the same.
502.4.5 Outdoor air intakes and exhaust openings. Stair and elevator	**6.4.3.4.1 Stair and Shaft Vents.** Stair and elevator shaft vents shall	The 2009 IECC provisions apply to vents and other intakes and openings

2009 IECC	Standard 90.1-07	Comparative Notes
shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be equipped with not less than a Class I motorized, leakage-rated damper with a maximum leakage rate of 4 cfm per square foot (6.8 L/s · C m2) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D.	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 Gravity Hoods, Vents, and Ventilators.** All *outdoor air* supply and exhaust hoods, vents, and ventilators shall be equipped with motorized dampers that will automatically shut when the spaces served are not in use.	in the building envelope while Standard 90.1-07 applies to all such vents, intakes, and openings. Beyond that, the scope of each document appears to be comparable. No other similar provisions appear in the HVAC-related provisions of the 2009 IECC. As such, it is possible IF an intake, opening, etc. were NOT in the building envelope; then no criteria for leakage would apply. It does not seem logical, however, for such intakes and openings not to be on the envelope because the opening would be the place where conditioned and unconditioned conditions intersect. On the issue of rate of leakage, the 2009 IECC and Standard 90.1-07 are identical for some climate zones but for others Standard 90.1-07 is less stringent. The exception to allow non-motorized dampers in more locations in Standard 90.1-07 would appear to be a loosening of stringency compared to the 2009 IECC. Note there is an apparent conflict in Standard 90.1-07, wherein exceptions allow non-motorized dampers in some climate zones but the reference table of maximum leakage rate would not allow those same dampers.
Exception: Gravity (nonmotorized) dampers are permitted to be used in buildings less than three stories in height above grade.	**Exceptions to 6.4.3.4.2** a. Gravity (nonmotorized) dampers are acceptable in buildings less than three stories in height above grade and for buildings of any height located in climate zones 1, 2, and 3. b. Ventilation systems serving *unconditioned spaces*. *There is a further Section 6.4.3.4.4 that references a table that provides maximum damper leakage rates of 4 cfm in zones 1, 2, 6, 7, and 8 and 10 cfm in all others. Also non-motorized dampers are not allowed in the former zones and the rate for the latter that are non-motorized is 20 and in some cases 40.*	It seems the exceptions are more limited in the 2009 IECC. Note the apparent conflict in Standard 90.1-07 between allowing certain non-motorized dampers via exception and then prohibiting them in the damper leakage table.
502.4.6 Loading dock	**5.4.3.3 Loading Dock**	The 2009 IECC does not limit

2009 IECC	Standard 90.1-07	Comparative Notes
weatherseals. Cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.	**Weatherseals.** In climate zones 4 through 8, cargo *doors* and loading dock *doors* shall be equipped with weatherseals to restrict *infiltration* when vehicles are parked in the doorway.	climate zones while Standard 90.1-07 essentially exempts climate zones 1 to 3. It is unclear, though, how this affects stringency in practice because there is no defined performance standard for weatherseals.
502.4.7 Vestibules. A door that separates *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.	**5.4.3.4 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.	This provision is essentially the same in both documents but there are some interpretive nuances. The definition of entrance doors in Standard 90.1-07 is much more precise than that found in the 2009 IECC. As such, it is logical to believe that more entrance doors would be required to have a vestibule under the former rather than the latter. The exceptions to the respective sections are not identical. Standard 90.1-07 has more exceptions for climate zones/floor areas. Sleeping units are exempt in the 2009 IECC but not in Standard 90.1-07 (e.g., hotels and motels). Standard 90.1-07 exempts building entrances with revolving doors while the 2009 IECC simply exempts revolving doors. As such, it would be more likely that Standard 90.1-07 would exempt more entrances because the exception is entrances that have revolving doors.
Exceptions: 1. Buildings in climate Zones 1 and 2 as indicated in Figure 301.1 and Table 301.1.	**Exceptions:** d. *Building entrances* in buildings located in climate zone 1 or 2. e. *Building entrances* in buildings located in climate zone 3 or 4 that are less than four stories above grade and less than 10,000 ft^2 in area f. *Building entrances* in buildings located in climate zone 5, 6, 7, or 8 that are less than 1000 ft^2 in area.	Climate zones 1 and 2 are both exempt. The 2009 IECC has no exemptions for other zones, while Standard 90.1-07 does.
2. Doors not intended to be used as a building *entrance door*, such as doors to mechanical or electrical equipment rooms.	b. *Doors* not intended to be used as a *building entrance.*	There is a subtle difference in the definitions or lack thereof for a building entrance. It is more likely under Standard 90.1-07 that a door will be an entrance door and be covered by the requirement than

2009 IECC	Standard 90.1-07	Comparative Notes
		under the 2009 IECC.
3. Doors opening directly from a *sleeping unit* or dwelling unit.	c. *Doors* opening directly from a *dwelling unit.*	Sleeping units are not exempt in Standard 90.1-07.
4. Doors that open directly from a space less than 3,000 square feet (298 m2) 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*.	
5. Revolving doors.	a. *Building entrances* with revolving *doors*.	Many entrances have revolving doors in them but the entrance also has swinging doors. One can interpret Standard 90.1-07 as saying if the entire entrance has a revolving door then the entire entrance is exempt.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.		
502.4.8 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 meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the *conditioned space* to the ceiling cavity. 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, and 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 2009 IECC doesn't specify a percentage limitation by which the provisions are not applicable as is the case in Standard 90.1-07 (<1% of opaque area of the assembly).,
SECTION 503 BUILDING MECHANICAL SYSTEMS		
503.1 General. Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Section 503.2 (referred to as the mandatory provisions) and either:	**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	There are some scope-related provisions in Standard 90.1-07 that address how to apply the document to additions and alterations of existing buildings. Those were not compared to Chapter 1 of the 2009

2009 IECC	Standard 90.1-07	Comparative Notes
1. Section 503.3 (Simple systems), or 2. Section 503.4 (Complex systems).	a. Section 6.3, Simplified Approach Option for HVAC Systems; or b. Section 6.4, Mandatory Provisions; and Section 6.5, Prescriptive Path.	IECC but are assumed to lead to the same end using both documents.
It appears that Section 503.3 of the 2009 IECC has provisions for simple systems that to some degree cover items in Section 6.3 from Standard 90.1-07.	**6.3 Simplified Approach Option for HVAC Systems**	The format of both documents makes it difficult to do a side-by-side comparison.
503.2 Provisions applicable to all mechanical systems (Mandatory).	**6.4 Mandatory Provisions**	
503.2.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with the procedures described in the ASHRAE/ACCA Standard 183. Heating and cooling loads shall be adjusted to account for load reductions that are achieved when energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively, design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in Chapter 3.	**6.4.2 Load Calculations** Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with generally accepted engineering standards and handbooks acceptable to the *adopting authority* (for example, *ASHRAE Handbook—Fundamentals*).	The 2009 IECC and Standard 90.1-07 appear to be comparable. While the former has additional information in the form of referencing ASHRAE/ACCA Standard 183, it is logical to conclude that one applying both provisions to the same building would most likely end up with identical or nearly identical results.
503.2.2 Equipment and system sizing. Heating and cooling equipment and systems capacity shall not exceed the loads calculated in accordance with Section 503.2.1. A single piece of equipment providing both heating and cooling must satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.		While Standard 90.1-07 does not have a comparable section to Section 503.2.2 of the 2009 IECC, it is assumed that the load calculations performed under Standard 90.1-07 will be used to size equipment and systems. Section 6.4.2 of Standard 90.1-07 would support this by saying "for the purpose of sizing systems".
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		

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that have the capability to sequence the operation of each unit based on load.		
503.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables 503.2.3(1), 503.2.3(2), 503.2.3(3), 503.2.3(4), 503.2.3(5), 503.2.3(6) and 503.2.3(7) when tested and rated in accordance with the applicable test procedure. 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 6.8.1G 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 *efficiency* requirements for operation at minimum capacity or other than standard rating conditions. 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 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	A comparison of the equipment efficiency tables indicates there are some differences in presentation.
Exception: Water-cooled centrifugal water-chilling packages listed in Table 503.2.3(7) not designed for operation at ARHI Standard 550/590 test conditions of 44°F (7°C) leaving	**6.4.1.2 Minimum Equipment Efficiencies—Listed Equipment—Nonstandard Conditions.** Water-cooled centrifugal water-chilling packages	A comparison of both documents indicates they are identical in terms of intent, but the 2009 IECC provides equations while Standard 90.1-07 provides tables. It is not

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chilled water temperature and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 I/s.kW) condenser water flow shall have maximum full load and NPLV ratings adjusted using the following equations: Adjusted maximum full load kW/ton rating = [full load kW/ton from Table 503.2.3(7)]/*K*adj Adjusted maximum NPLV rating = [IPLV from Table 503.2.3(7)]/*K*adj where: *K*adj = 6.174722 - 0.303668(X) + 0.00629466(*X*)2 - 0.000045780(*X*)3 *X* =*DT*std + LIFT *DTstd* = {24+[full load kW/ton from Table 503.2.3(7)] × 6.83}/Flow Flow = Condenser water flow (GPM)/Cooling Full Load Capacity (tons) LIFT = CEWT – CLWT (°F) CEWT = Full Load Condenser Entering Water Temperature (°F) CLWT = Full Load Leaving Chilled Water Temperature (°F) The adjusted full load and NPLV values are only applicable over the following full-load design ranges: Minimum Leaving Chilled Water Temperature: 38°F (3.3°C) Maximum Condenser Entering Water Temperature: 102°F (38.9°C) Condensing Water Flow: 1 to 6 gpm/ton (0.018 to 0.1076 1/s *kW) and X >=39 and _<=60	that are not designed for operation at ARI Standard 550/590 test conditions (and, thus, cannot be tested to meet the requirements of Table 6.8.1C) of 44°F leaving chilled-water temperature and 85°F entering condenser-water temperature with 3 gpm/ton condenser-water flow shall have a minimum full-load COP and a minimum *NPLV* rating as shown in the tables referenced below. a. Centrifugal chillers <150 tons shall meet the minimum full-load COP and IPLV/NPLV in Table 6.8.1H. b. Centrifugal chillers >150 tons and <300 tons shall meet the minimum full-load COP and IPLV/NPLV in Table 6.8.1I. c. Centrifugal chillers >=300 tons shall meet the minimum full-load COP and IPLV/NPLV in Table 6.8.1J. The table values are only applicable over the following full-load design ranges: • Leaving Chiller-Water Temperature: 40°F to 48°F • Entering Condenser-Water Temperature: 75°F to 85°F • Condenser-Water Temperature Rise: 5°F to 15°F Chillers designed to operate outside of these ranges or applications utilizing fluids or solutions with secondary coolants (e.g., glycol solutions or brines) with a freeze point of 27°F or lower for freeze protection are not covered by this standard.	clear if these are identical. Note also that addenda to Standard 90.1-07 would change the standard from tables back to equations.

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Chillers designed to operate outside of these ranges or applications utilizing fluids or solutions with secondary coolants (e.g., glycol solutions or brines) with a freeze point of 27°F (-2.8°C) or lower for freeze protection are not covered by this code.		
	6.4.1.3 Equipment Not Listed. Equipment not listed in the tables referenced in Sections 6.4.1.1 and 6.4.1.2 may be used.	N/A
503.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables 503.2.3(1), 503.2.3(2), 503.2.3(3), 503.2.3(4), 503.2.3(5), 503.2.3(6) and 503.2.3(7) when tested and rated in accordance with the applicable test procedure. 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.	**6.4.1.4 Verification of Equipment Efficiencies.** Equipment *efficiency* information supplied by *manufacturers* shall be verified as follows: a. Equipment covered under EPACT shall comply with U.S. Department of Energy certification requirements. b. If a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment *efficiency* ratings, then the product shall be listed in the certification program, or c. If a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment *efficiency* ratings, but the product is not listed in the existing certification program, the ratings shall be verified by an independent laboratory test report, or d. if no certification program exists for a covered product, the equipment *efficiency* ratings shall be supported by data furnished by the *manufacturer*, or e. where components such as indoor or outdoor coils from different *manufacturers* are used, the system designer shall specify component efficiencies whose combined *efficiency* meets the minimum equipment *efficiency* requirements in Section 6.4.1. f. Products covered in Table 6.8.1G shall have efficiency ratings	The text in Standard 90.1-07 that relates to certification and validation of efficiencies is appropriate for a design standard. In the 2009 IECC, language on the efficiency verification issue, which is more appropriate for a code, is provided. These provisions are comparable and would appear to lead to the same end even though they're not identical.

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	supported by data furnished by the manufacturer.	
	6.4.1.5.1 Mechanical Equipment. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the *manufacturer* stating that the equipment complies with the requirements of Standard 90.1.	There is no parallel provision in the 2009 IECC, and while this does help with inspection and enforcement, it cannot be determined whether it increases stringency.
Table 503.2.3(3) contains in footnote "c" a similar statement.	**6.4.1.5.2 Packaged Terminal Air Conditioners.** Packaged terminal air conditioners and heat pumps with sleeve sizes less than 16 in. high and 42 in. wide shall be factory labeled as follows: *Manufactured for replacement applications only: not to be installed in new construction projects.*	The documents are the same.
503.2.4 HVAC system controls. Each heating and cooling system shall be provided with thermostatic controls as required in Section 503.2.4.1, 503.2.4.2, 503.2.4.3, 503.2.4.4, 503.4.1, 503.4.2, 503.4.3 or 503.4.4.	**6.4.3.1 Zone Thermostatic Controls**	The stringency is equivalent for both.
503.2.4.1 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.	**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.*	Both are comparable.
Exception: Independent perimeter systems that are designed to offset only building envelope heat losses or gains or both serving one or more perimeter zones 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 (15.2 m); and 2. The perimeter system heating	**Exceptions to 6.4.3.1.1** 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	The text is essentially the same.

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and cooling supply is controlled by a thermostat(s) located within the zone(s) served by the system.	thermostatic control(s) located within the zones(s) served by the system. Exterior walls are considered to have different *orientations* if the directions they face differ by more than 45 degrees.	
503.2.4.1.1 Heat pump supplementary heat. Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation when 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. **Exceptions:** 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 90.1-07 refers to conditions of steady-state operation and setback recovery while the 2009 IECC does not, so Standard 90.1-07 could be considered slightly more stringent here.
503.2.4.2 Set point overlap restriction. Where used to control both heating and cooling, *zone* thermostatic controls shall provide a temperature range or dead band 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.	**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. **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.	The text appears to be the same in both documents with respect to dead band. The 2009 IECC does not contain provisions to address separate heating and cooling thermostats as in Section 6.4.3.2 of Standard 90.1-07. As such, where those conditions are found in a building, it is more likely a building constructed to Standard 90.1-07 would have the capability to save energy in operations while the same building constructed to the 2009 IECC would not.
Exception: Thermostats requiring manual changeover between heating and cooling modes.	**Exceptions to 6.4.3.1.2** a. Thermostats that require manual changeover between heating and cooling modes.	Standard 90.1-07 has an additional exception for special occupancy or special applications that is not specifically in the 2009 IECC when

2009 IECC	Standard 90.1-07	Comparative Notes
	b. Special occupancy or special applications where wide temperature ranges are not acceptable (such as retirement homes, process applications, museums, some areas of hospitals) and are approved by the *authority having jurisdiction*.	approved by the authority having jurisdiction. The International Code Council (ICC) codes generally have such an exception in Chapter 1 of the ICC codes that would generally allow for such an exception. As such, the documents are considered comparable.
503.2.4.3Off-hour controls. Each zone shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system.	**6.4.3.3 Off-Hour Controls.** HVAC systems shall have the off-hour controls required by Sections 6.4.3.3.1 through 6.4.3.3.4.	
Exceptions: 1. Zones that will be operated continuously. 2. Zones with a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a readily accessible manual shutoff switch.	**Exceptions to 6.4.3.3** a. *HVAC systems* intended to operate continuously. *b*. *HVAC systems* having a design heating capacity and cooling capacity less than 15,000 Btu/h that are equipped with readily accessible manual ON/OFF controls.	Exception 2 in the 2009 IECC is more stringent than the comparable exception b in Standard 90.1-07. As such, it is possible that some systems would not have such controls under the latter while they would under the former and as a result might not be capable of being operated as efficiently.
503.2.4.3.1 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 or to prevent high space-humidity levels. Exception: Radiant floor and ceiling heating systems.	The provisions of Standard 90.1-07 appear to be more stringent than those of the 2009 IECC and, as such, systems constructed to the former would be more likely to be operated to save additional energy.
503.2.4.3.2 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	**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,	The provisions of Standard 90.1-07 appear to be more stringent than those of the 2009 IECC and, as such, systems constructed to the former would be more likely to be operated to save additional energy.

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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.	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.	
	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 occupied setpoint and the amount of time prior to scheduled occupancy.	The provisions of Standard 90.1-07, in addressing the subject controls, would appear to be more stringent than those of the 2009 IECC and, as such, systems constructed to the former would be more likely to be operated to save additional energy.
	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 ft^2 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,	The provisions of Standard 90.1-07, in addressing the subject controls, would appear to be more stringent than those of the 2009 IECC and, as such, systems constructed to the former would be more likely to be operated to save additional energy.

2009 IECC	Standard 90.1-07	Comparative Notes
	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.	
503.2.4.4 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.	**6.4.3.4.3 Shutoff Damper Controls.** Both *outdoor air* supply 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* dampers shall be capable of automatically shutting off during preoccupancy building warm-up, cool down, and *setback,* except when *ventilation* reduces energy costs (e.g., night purge) or when ventilation must be supplied to meet code requirements.	The provisions of Standard 90.1-07 address automatic shutoff of ventilation outdoor air dampers during some conditions where the building could be occupied and, as such, could provide the capability for a building meeting Standard 90.1-07 to have reduced energy use than a building just meeting the 2009 IECC.
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.	**Exceptions to 6.4.3.4.3** a. Gravity (nonmotorized) dampers are acceptable in buildings less than three stories in height and for buildings of any height located in climate zones 1, 2, and 3. b. Gravity (nonmotorized) dampers are acceptable in systems with a design *outdoor air* intake or exhaust capacity of 300 cfm or less.	The exception is the same in both documents.

2009 IECC	Standard 90.1-07	Comparative Notes
502.4.5 Outdoor air intakes and exhaust openings. Stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be equipped with not less than a Class I motorized, leakage-rated damper with a maximum leakage rate of 4 cfm per square foot (6.8 L/s C m^2) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D. **Exception:** Gravity (nonmotorized) dampers are permitted to be used in buildings less than three stories in height above grade.	**6.4.3.4.4 Dampers.** Where *outdoor air* supply and exhaust air dampers are required by Section 6.4.3.4, they shall have a maximum leakage rate when tested in accordance with AMCA Standard 500 as indicated in Table 6.4.3.4.4. **Exceptions to 6.4.3.4.3** a. Gravity (nonmotorized) dampers are acceptable in buildings less than three stories in height and for buildings of any height located in climate zones 1, 2, and 3.	The provisions in both documents are comparable.
	6.4.3.4.5 Ventilation Fan Controls. Fans with motors greater than 0.75 hp (0.5 kW) shall have automatic controls complying with Section 6.4.3.3.1 that are capable of shutting off fans when not required. **Exception:** *HVAC systems* intended to operate continuously.	The provisions of Standard 90.1-07 address automatic shutoff of ventilation fans while the 2009 IECC does not. As such, the former could provide the capability for a building meeting Standard 90.1-07 to have reduced energy use than a building just meeting the 2009 IECC.
	6.4.3.6 Humidifier Preheat. Humidifiers with preheating jackets mounted in the airstream shall be provided with an automatic valve to shut off preheat when humidification is not required.	The provisions of Standard 90.1-07 address humidifier preheat while the 2009 IECC does not. As such, the former could provide the capability for a building meeting Standard 90.1-07 to have reduced energy use than a building just meeting the 2009 IECC.
	6.4.3.7 Humidification and Dehumidification Where a *zone* is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided capable of preventing simultaneous operation of humidification and dehumidification equipment. **Exceptions**: a. Zones served by desiccant systems, used with direct evaporative cooling in series. b. Systems serving zones where	The provisions of Standard 90.1-07 address humidification and dehumidification capability while the 2009 IECC does not. As such, the former could provide the capability for a building meeting Standard 90.1-07 to have reduced energy use than a building just meeting the 2009 IECC.

2009 IECC	Standard 90.1-07	Comparative Notes
	specific humidity levels are required, such as museums and hospitals, and approved by the *authority having jurisdiction*.	
503.2.4.5 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 heat 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 protected 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 in both documents are comparable.
503.2.5 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.*		There is a reference to ASHRAE Standard 62.1 (minimum ventilation requirements) in Standard 90.1-07, 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 90.1-07 would not be considered significant.
503.2.5.1 Demand controlled ventilation. Demand control ventilation (DCV) is required for spaces larger than 500 ft2 (50m2) and with an average occupant load of 40 people per 1000 ft2 (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	**6.4.3.9 Ventilation Controls for High-Occupancy Areas.** Demand control ventilation (DCV) is required for spaces larger than 500 ft^2 and with a design occupancy for ventilation of greater than 40 people per 1000 ft^2 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, or c. a design outdoor airflow greater than 3000 cfm.	The text is the same in both documents.

2009 IECC	Standard 90.1-07	Comparative Notes
than 3,000 cfm (1400 L/s).		
Exceptions: 1. Systems with energy recovery complying with Section 503.2.6. 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).	**Exceptions to 6.4.3.9** a. Systems with energy recovery complying with Section 6.5.6.1. 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. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1200 cfm.	The text is the same in both documents.
503.2.6 Energy recovery ventilation systems. Individual fan systems that have both a design supply air capacity of 5,000 cfm (2.36 m^3/s) or greater and a minimum outside air supply of 70% or greater of the design supply air quantity shall have an energy recovery system that provides a change in the enthalpy of the outdoor air supply of 50% or more of the difference between the outdoor air and return air at design conditions. Provision shall be made to bypass or control the energy recovery system to permit cooling with outdoor air where cooling with outdoor air is required.	**6.5.6.1 Exhaust Air Energy Recovery.** Individual fan systems that have both a design supply air capacity of 5000 cfm or greater and have a minimum *outdoor air* supply of 70% or greater of the design supply air quantity shall have an energy recovery system with at least 50% 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 at design conditions. Provision shall be made to bypass or control the heat recovery system to permit air economizer operation as required by Section 6.5.1.1.	The text is essentially the same in both documents.
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% or less of design values. 2.2. Direct makeup (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no	**Exceptions to 6.5.6.1** a. Laboratory systems meeting Section 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 systems in climate zones 1 through 3. g. Cooling systems in climate zones	The text is essentially the same in both documents.

2009 IECC	Standard 90.1-07	Comparative Notes
warmer than 2°F (1.1°C) below room setpoint, cooled to no cooler than 3°F (1.7°C) above room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control. 3. Systems serving spaces that are not cooled and are heated to less than 60°F (15.5°C). 4. Where more than 60% of the outdoor heating energy is provided from site-recovered or site solar energy. 5. Heating systems in climates with less than 3,600 HDD. 6. Cooling systems in climates with a 1-percent cooling design wet-bulb temperature less than 64°F (18°C). 7. Systems requiring dehumidification that employ series-style energy recovery coils wrapped around the cooling coil.	3c, 4c, 5b, 5c, 6b, 7, and 8. h. Where the largest exhaust source is less than 75% of the design outdoor airflow. i. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.	
(Section 303 contains provisions for insulation installation)	**6.4.4.1.1 General.** Insulation required by this section shall be installed in accordance with industry-accepted standards (see Informative Appendix E). These requirements do not apply to HVAC equipment. Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, but not limited to the following: a. Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material. b. Insulation covering chilled-water piping, refrigerant suction piping, or cooling ducts located outside the conditioned space shall include a vapor retardant located	The 2009 IECC contains some general requirements about installation of insulation, but they are not as robust as those found in Standard 90.1-07. It is assumed, however, that because the International Mechanical Code is used with the 2009 IECC and would apply to mechanical systems design and construction, that the provisions of Standard 90.1-07 are covered in other ICC codes.

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	outside the insulation (unless the insulation is inherently vapor retardant), all penetrations and joints of which shall be sealed.	
503.2.7 Duct and plenum insulation and sealing. All supply and return air ducts and plenums shall be insulated with a minimum of R-5 insulation when located in unconditioned spaces and a minimum of R-8 insulation when located outside the building. When 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.	**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.	Despite a simplified approach in the 2009 IECC, the stringency of the two documents appears to be basically equal.
Exceptions: 1. When located within equipment. 2. When 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*.	**Exceptions to 6.4.4.1.2** 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, *semi-heated 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 ft^2 need not exceed R-2; those 5 ft^2 or smaller need not be insulated.	There is no apparent difference in stringency associated with the exceptions.
503.2.7.1 Duct construction. Ductwork shall be constructed and erected in accordance with the *International Mechanical Code*.	**Section 6.4.4 is entitled duct 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 2009 IECC is part of a coordinated set of codes and has duct construction provisions in the International Mechanical Code to refer to. ASHRAE Standard 90.1-07 does not contain provisions for duct construction per se, but one building to Standard 90.1-07 would likely be responsible for meeting applicable state or local mechanical codes that address duct construction.
503.2.7.1.1 Low-pressure duct systems. All longitudinal and	**Section 6.4.4.2 has provisions that govern duct sealing. It provides**	A comparison of the provisions in the 2009 IECC and Standard 90.1-07

2009 IECC	Standard 90.1-07	Comparative Notes
transverse joints, seams and connections of supply and return ducts operating at a static pressure less than or equal to 2 inches 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*.	**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.**	appear to indicate that the former is equal to, or more rigorous than, the latter.
Exception: Continuously welded and locking-type longitudinal joints and seams on ducts operating at static pressures less than 2 inches w.g. (500 Pa) pressure classification.		Standard 90.1-07 does require longitudinal seams on supply ducts <2" w.g. located outdoors and in unconditioned spaces and, as such, would be more stringent than the 2009 IECC.
503.2.7.1.2 Medium-pressure duct systems. All ducts and plenums designed to operate at a static pressure greater than 2 inches w.g. (500 Pa) but less than 3 inches w.g. (750 Pa) shall be insulated and sealed in accordance with Section 503.2.7. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the *International Mechanical Code*.		
503.2.7.1.3 High-pressure duct systems. Ducts designed to operate at static pressures in excess of 3 inches w.g. (746 Pa) shall be insulated and sealed in accordance with Section 503.2.7. 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 5-2. $CL=F^* P0.65$ **(Equation 5-2)** where: *F* = The measured leakage rate in cfm per 100 square feet of duct	**6.4.4.2.2 Duct Leakage Tests.** Ductwork that is designed to operate at static pressures in excess of 3 in. w.c. 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. Duct systems with pressure ratings in excess of 3 in. w.c. shall be identified on the drawings. The maximum permitted duct leakage shall be $L_{max} = C_L P^{0.65}$, Where	The 2009 IECC sets a limit of 6.0 air leakage while Standard 90.1-07 allows the limit to float based on the equation. A comparison of different duct-shape and pressure-rating scenarios would be needed to determine the equivalency of the documents. Note that the latter does require identification of high-pressure duct systems on the drawings.

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surface. P = The static pressure of the test. Documentation shall be furnished by the designer demonstrating that representative sections totaling at least 25% of the duct area have been tested and that all tested sections meet the requirements of this section.	L_{max} = maximum permitted leakage in cfm/100 ft^2 duct surface area; C_L = duct leakage class, cfm/100 ft^2 at 1 in. w.c., 6 for rectangular sheet metal, rectangular fibrous, and round flexible ducts, 3 for round/flat oval sheet metal or fibrous glass ducts; and P = test pressure, which shall be equal to the design duct pressure class rating in in. w.c.	
503.2.8 Piping insulation. All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table 503.2.8.	**6.4.4.1.3 Piping Insulation.** Piping shall be thermally insulated in accordance with Table 6.8.3.	The 2009 IECC has a much smaller and simpler table than the parallel table in Standard 90.1-07. The chilled water piping provisions in the former are always greater than or equal to those in the latter. The hot water or steam piping provisions are, in some cases, more stringent in the former and in others, more stringent in the latter.
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 55°F (13°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. Runout piping not exceeding 4 feet (1219 mm) in length and 1 inch (25 mm) in diameter between the control valve and HVAC coil.	**Exceptions to 6.4.4.1.3** 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 nonrenewable energy (such as roof and condensate drains, domestic cold water supply, natural gas piping, or refrigerant liquid piping) or where heat gain or heat loss will not increase energy usage. d. Hot-water piping between the shutoff valve and the coil, not exceeding 4 ft. in length, when located in *conditioned spaces*. e. Pipe unions in heating systems (steam, steam condensate, and hot water).	The text in both documents is essentially the same, although chilled water piping operating from 55 to 60° F must be insulated in Standard 90.1-07 and not in the 2009 IECC.
503.2.9.1 Air system balancing. Each supply air outlet and *zone* terminal device shall be equipped with means for air balancing in accordance with the requirements of	**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	The text cannot be compared. The 2009 IECC requires a means to balance, such as registers, while Standard 90.1-07 requires systems to be balanced. It is likely that the

2009 IECC	Standard 90.1-07	Comparative Notes
Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 horsepower (hp) (7.4 kW) and larger.	speed shall be adjusted to meet design flow conditions.	latter does not have provisions for dampers and registers that allow for balancing and assumes a requirement for the system to be balanced would necessitate installing such devices. Note also that Standard 90.1-07 requires adjustments to fan speed for balancing for any fan over 1 hp. The 2009 IECC does not have this requirement until 10 hp, and allows discharge dampers for balancing, which result in increased pressure drop and energy usage. As such, Standard 90.1-07 could be considered more stringent than the 2009 IECC in certain conditions.
503.2.9.2 Hydronic system balancing. Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections.	**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.	See above for air system balancing. The same situation appears to exist for hydronic systems. Note that the requirement in Standard 90.1-07 to trim the impeller is a much more efficient method of balancing than some sort of a throttling valve.
No corresponding section	**Exception to 6.7.2.3.3** Impellers need not 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.	
503.2.9.3 Manuals. The construction documents shall require that an operating and maintenance manual be provided to the building owner by the mechanical contractor. The manual shall include, at least, the following: 1. Equipment capacity (input and output) and required maintenance actions. 2. Equipment operation and maintenance manuals. 3. HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions.	**6.7.2.2 Manuals.** Construction documents shall require that an operating manual and a 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 be in accordance with industry-accepted standards (see Informative Appendix E) and shall include, at a minimum, the following: a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.	The text of both documents appears to be comparable.

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Desired or field-determined setpoints shall be permanently recorded on control drawings, at control devices or, for digital control systems, in programming comments. 4. A complete written narrative of how each system is intended to operate.	b. 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. c. Names and addresses of at least one *service agency*. d. HVAC controls system maintenance and calibration 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 programming comments. e. A complete narrative of how each system is intended to operate, including suggested setpoints.	
503.2.10 Air system design and control. Each HVAC system having a total fan system motor nameplate horsepower (hp) exceeding 5 horsepower (hp) shall meet the provisions of Sections 503.2.10.1 through 503.2.10.2.	**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 Sections 6.5.3.1 through 6.5.3.2.	The text in both documents is essentially the same for all the air system design and control provisions.
503.2.10.1 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 503.2.10.1(1). This includes supply fans, return/relief fans, and fan-powered terminal units associated with systems providing heating or cooling capability.	**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.	
Exceptions: 1. Hospital 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.	a. Hospital 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	

2009 IECC	Standard 90.1-07	Comparative Notes
2. Individual exhaust fans with motor nameplate horsepower of 1 hp or less. 3. Fans exhausting air from fume hoods. (Note: If this exception is taken, no related exhaust side credits shall be taken from Table 503.2.10.1(2) and the Fume Exhaust Exception Deduction must be taken from Table 503.2.10.1(2).	motor nameplate horsepower of 1 hp or less. c. Fans exhausting air from fume hoods. ***Note:*** If this exception is taken, no related exhaust side credits shall be taken from Table 6.5.3.1.1B and the Fume Hood Exhaust Exception Deduction must be taken from Table 6.5.3.1.1B.	
503.2.10.2 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*.	**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.	The text in both documents is the same.
Exceptions: 1. For fans less than 6 bhp, where the first available motor larger than the brake horsepower has a nameplate rating within 50% of the bhp, selection of the next larger nameplate motor size is allowed. 2. For fans 6 bhp and larger, where the first available motor larger than the bhp has a nameplate rating within 30% of the bhp, selection of the next larger nameplate motor size is allowed.	**Exceptions:** a. For fans less than 6 bhp, where the first available motor larger than the brake horsepower 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 with 30% of the bhp, the next larger nameplate motor size may be selected.	
503.3 Simple HVAC systems and equipment (Prescriptive). This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables 503.2.3(1) through 503.2.3(5), 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. This section does not apply to fan systems serving multiple zones, nonunitary or nonpackaged HVAC equipment and systems or hydronic or steam heating and hydronic cooling equipment and distribution systems that provide cooling or	**It appears that Section 6.3 has provisions for simple systems that to some degree cover items in Chapter 5.**	The format of both documents makes it difficult to do a side-by-side comparison.

2009 IECC	Standard 90.1-07	Comparative Notes
cooling and heating which are covered by Section 503.4.		
503.3.1 Economizers. Supply air economizers shall be provided on each cooling system as shown in Table 503.3.1(1). Economizers shall be capable of providing 100-percent outdoor air, even if additional mechanical cooling is required to meet the cooling load of the building. Systems shall provide a means to relieve excess outdoor air during economizer operation to prevent overpressurizing the building. The relief air outlet shall be located to avoid recirculation into the building. Where a single room or space is supplied by multiple air systems, the aggregate capacity of those systems shall be used in applying this requirement.	**Section 6.5.1 provides criteria for economizers.**	The 2009 IECC has requirements for economizers by climate zone and cooling capacity. It also has a tradeoff that allows the omission of economizers in certain climates if equipment efficiency is increased. The 2009 IECC has similar provisions, but the climate zone and equipment size criteria do not match those found in Standard 90.1-07. They are the same in climate zones 1 and 2a, and in zones 7 and 8. The 2009 IECC does not require them and Standard 90.1-07 does when it is at least a 135K-system size. In climate zones 3a and 4a, they are not required by Standard 90.1-07, but they are in the 2009 IECC for systems greater than or equal to a54K-system size. For the rest of the climate zones, both documents require them, but the 2009 IECC starts at 54K and Standard 90.1-07 at 65K. There are more exceptions in Standard 90.1-07 than in the 2009 IECC.
Exceptions:		
1. Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(1) or 503.2.3(2) and meets or exceeds the minimum cooling efficiency requirement (EER) by the percentages shown in Table 503.3.1(2).		
2. Systems with air or evaporatively cooled condensors and which serve spaces with open case refrigeration or that require filtration equipment in order to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.		
503.3.2 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 503.4.3.		There does not appear to be an exception in Standard 90.1-07 as there is in the 2009 IECC for systems <300K in size, which would make Standard 90.1-07 more stringent.

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503.4.3 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 503.4.3.1 through 503.4.3.3. 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 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.
503.4.3.1 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 the same.
503.4.3.2 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 the same.
503.4.3.3 Hydronic (water loop) heat pump systems. Hydronic heat pump systems shall comply with Sections 503.4.3.3.1 through 503.4.3.3.3.	**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.,	A review of both documents finds them to be about the same.

2009 IECC	Standard 90.1-07	Comparative Notes
	cooling tower) and heat addition (e.g., boiler) shall have the following:	
503.4.3.3.1 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.	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).	A review of both documents finds them to be about the same.
Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on real time conditions of demand and capacity, dead bands of less than 20°F (11°C) shall be permitted.	**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.	A review of both documents finds them to be about the same.
503.4.3.3.2 Heat rejection. Heat rejection equipment shall comply with Sections 503.4.3.3.2.1 and 503.4.3.3.2.2. **Exception:** Where it can be demonstrated that a heat pump system will be required to reject heat throughout the year.		
503.4.3.3.2.1 Climate Zones 3 and 4. For Climate Zones 3 and 4 as indicated in Figure 301.1 and Table 301.1: 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,	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 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 shutting down the circulation pump on the cooling tower loop.	The 2009 IECC separates the provisions so they apply to different climate zones, while Standard 90.1-07 applies the requirements to the same climate zones but does not separate them.

2009 IECC	Standard 90.1-07	Comparative Notes
then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.		
503.4.3.3.2.2 Climate Zones 5 through 8. For climate Zones 5 through 8 as indicated in Figure 301.1 and Table 301.1, if an open- or closed-circuit cooling tower is used, then a separate heat exchanger shall be required 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.		
503.4.3.3.3 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 Pump Systems.** Each hydronic heat pump shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off	The provisions are the same except the 2009 IECC provisions do not apply until the pump rating is over 10 hp. As such, Standard 90.1-07 would be more stringent in situations of 10 hp or less.
	6.5.2.3 Dehumidification. Where humidistatic controls are provided, such controls shall prevent reheating, mixing of hot and cold airstreams, or other means of simultaneous heating and cooling of the same airstream. **Exceptions:** a. The system is capable of reducing supply air volume to 50% or less of the design airflow rate or the minimum rate specified in Section 6.2 of Standard 62.1, whichever is larger, before simultaneous heating and cooling takes place. b. The individual fan cooling unit has a design cooling capacity of 80,000 Btu/h or less and is capable of unloading to 50% capacity before simultaneous heating and cooling takes place. c. The individual mechanical cooling unit has a design cooling capacity of 40,000 Btu/h or less. An individual mechanical cooling unit is a single system composed of a fan or fans and a cooling coil capable of providing	There do not appear to be any dehumidification provisions in the 2009 IECC. It may be that Standard 90.1-07 applies where the controls are installed, but there is no requirement for them to be installed. Under a minimum code, if they are not required, there is no reason to provide criteria for their installation should someone decide to install dehumidification.

2009 IECC	Standard 90.1-07	Comparative Notes
	mechanical cooling. d. Systems serving spaces where specific humidity levels are required to satisfy process needs, such as computer rooms, museums, surgical suites, and buildings with refrigerating systems, such as supermarkets, refrigerated warehouses, and ice arenas. This exception also applies to other applications for which fan volume controls in accordance with Exception (a) are proven to be impractical to the enforcement agency. e. 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. f. Systems where the heat added to the airstream is the result of the use of a desiccant system and 75% of the heat added by the desiccant system is removed by a heat exchanger, either before or after the desiccant system with energy recovery.	
	6.5.2.4 Humidification. Systems with hydronic cooling and humidification systems designed to maintain inside humidity at a dew-point temperature greater than 35°F shall use a water economizer if an economizer is required by Section 6.5.1.	
503.3.1 Economizers. Supply air economizers shall be provided on each cooling system as shown in Table 503.3.1(1). Economizers shall be capable of providing 100-percent outdoor air, even if additional mechanical cooling is required to meet the cooling load of the building. Systems shall provide a means to relieve excess outdoor air during economizer operation to prevent overpressurizing the building. The relief air outlet shall be located to avoid recirculation into the building. Where a single room or space is supplied by multiple air systems, the aggregate capacity of	**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.	A comparison of the 2009 IECC and Standard 90.1-07 finds the documents to be different. Both require 100% outdoor air capability. The 2009 IECC requires "integrated economizers," which is covered in its own section in Standard 90.1-07 (6.5.1.3), except the standard adds some exceptions based on coil capacity, climate zone, and coil freeze protection.

2009 IECC	Standard 90.1-07	Comparative Notes
those systems shall be used in applying this requirement.		
	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).	Standard 90.1-07 provides important guidance into controls requirements for economizers that are missing from the 2009 IECC.
	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 for these control types shall be those listed in Table 6.5.1.1.3B.	Standard 90.1-07 provides important guidance into controls requirements for economizers that are missing from the 2009 IECC.
	6.5.1.1.4 Dampers. Both return air and *outdoor air* dampers shall meet the requirements of Section 6.4.3.3.4. (zone isolation requirements)	The 2009 IECC does not appear to have a comparable requirement.
	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.	The 2009 IECC does not appear to have a comparable requirement.
	6.5.1.2.1 Design Capacity. Water economizer systems shall be capable of cooling supply air by indirect evaporation and 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. **Exception:** Systems in which a water economizer is used and where	The 2009 IECC does not appear to have a comparable requirement.

2009 IECC	Standard 90.1-07	Comparative Notes
	dehumidification requirements cannot be met using *outdoor air* temperatures of 50°F dry bulb/45°F wet bulb must satisfy 100% of the expected system cooling load at 45°F dry bulb/40°F wet bulb.	
	6.5.1.2.2 Maximum Pressure Drop. Precooling coils and water-to-water heat 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.	The 2009 IECC does not appear to have a comparable requirement.
	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. **Exceptions:** a. 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% of the total system capacity. b. Individual direct expansion units that have a rated cooling capacity less than 65,000 Btu/h and use nonintegrated economizer controls that preclude simultaneous operation of the economizer and mechanical cooling. c. Systems in climate zones 1, 2, 3a, 4a, 5a, 5b, 6, 7, and 8.	The 2009 IECC does not appear to have a comparable requirement.
	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.	The 2009 IECC does not appear to have a comparable requirement.

2009 IECC	Standard 90.1-07	Comparative Notes
	Exception: Economizers on VAV systems that cause zone level heating to increase due to a reduction in supply air temperature.	
503.4.2Variable air volume (VAV) fan control. Individual VAV fans with motors of 10 horsepower (7.5 kW) or greater shall be: 1. Driven by a mechanical or electrical variable speed drive; or 2. The fan motor shall have controls or devices that will result in fan motor demand of no more than 30% of their design wattage at 50% of design airflow when static pressure set point equals one-third of the total design static pressure, based on manufacturer's certified fan data. 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.	**6.5.3.2.1 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 *manufacturers'* certified fan data.	The documents are comparable to a point. The provisions from Sections 6.5.3.2.2 and 6.5.3.2.1b of Standard 90.1-07 are not found in the 2009 IECC.
	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.	The 2009 IECC does not give direction on location of the static pressure sensor and, as such, could be considered less stringent than Standard 90.1-07.
503.4.2Variable air volume (VAV) fan 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,	**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	The provisions in both documents appear to be compatible.

2009 IECC	Standard 90.1-07	Comparative Notes
i.e., the set point is reset lower until one *zone* damper is nearly wide open.	open.	
503.4.3 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 503.4.3.1 through 503.4.3.3. 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 input design capacity shall include either a multistaged or modulating burner.		The provisions in both documents appear to be compatible.
503.4.3.1 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.	The provisions in both documents appear to be compatible.
503.4.3.2 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.	The provisions in both documents appear to be compatible.
503.4.3.3 Hydronic (water loop) heat pump systems. Hydronic heat pump systems shall comply with Sections 503.4.3.3.1		

2009 IECC	Standard 90.1-07	Comparative Notes
through 503.4.3.3.3.		
503.4.3.3.1 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 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 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 shutting down the circulation pump on the cooling tower loop.	The provisions in both documents appear to be compatible.
Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on real-time conditions of demand and capacity, dead bands of less than 20°F (11°C) shall be permitted.	**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.	The provisions in both documents appear to be compatible.
503.4.3.3.2 Heat rejection. Heat rejection equipment shall comply with Sections 503.4.3.3.2.1 and 503.4.3.3.2.2. **Exception:** Where it can be demonstrated that a heat pump system will be required to reject heat		The provisions in both documents appear somewhat similar.

2009 IECC	Standard 90.1-07	Comparative Notes
throughout the year.		
503.4.3.3.2.1 Climate Zones 3 and 4. For Climate Zones 3 and 4 as indicated in Figure 301.1 and Table 301.1: 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 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 shutting down the circulation pump on the cooling tower loop.	The provisions in both documents appear to be somewhat similar. The 2009 IECC has provisions for climate zones 3 and 4 and then climate zones 5 to 8, while Standard 90.1-07 has one set of provisions for climate zones 3 to 8.
503.4.3.3.2.2 Climate Zones 5 through 8. For climate Zones 5 through 8 as indicated in Figure 301.1 and Table 301.1, if an open- or closed-circuit cooling tower is used, then a separate heat exchanger shall be required 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.		
503.4.3.3.3 Two position valve. Each hydronic heat pump on the	**6.5.4.4 Hydronic (Water Loop) Heat Pump Systems.** Each	The provisions in both documents appear to be compatible (see Section

2009 IECC	Standard 90.1-07	Comparative Notes
hydronic system having a total pump system power exceeding 10 horsepower (hp) (7.5 kW) shall have a two-position valve.	hydronic heat pump shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.	6.5.4 below for the 10-hp limitation in Standard 90.1-07).
	6.5.4 Hydronic System Design and Control. HVAC hydronic systems having a total *pump system power* exceeding 10 hp shall meet provisions of Sections 6.5.4.1 through 6.5.4.4.	There does not appear to be a size limit on pump system power in the 2009 IECC.
503.4.3.4 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.
503.4.3.4 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	**6.5.4.1 Hydronic Variable Flow Systems.** HVAC pumping systems that include control valves designed to modulate or step open and close as a function of load shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to 50% or less of the design flow rate. Individual pumps serving variable flow systems having a pump head exceeding 100 ft. and motor exceeding 50 hp shall	The provisions are somewhat the same.

2009 IECC	Standard 90.1-07	Comparative Notes
temperature as an indicator of building heating or cooling demand. The temperature shall be capable of being reset by at least 25% of the design supply-to-return water temperature difference; or 2. Reduce system pump flow by at least 50% 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.	have controls and/or devices (such as variable speed control) that will result in pump motor demand of no more than 30% of design wattage at 50% of design water flow. The controls or devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. Differential pressure shall be measured at or near the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure. **Exception:** a. Systems where the minimum flow is less than the minimum flow required by the equipment *manufacturer* for the proper operation of equipment served by the system, such as chillers, and where total pump system power is 75 hp or less. b. Systems that include no more than three control valves.	
503.4.3.5 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 one 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 purpose of increased temperature differential, shall be considered as one chiller. When a boiler plant includes more than one boiler, provisions shall be made so that the flow in the boiler plant can be automatically reduced, correspondingly, when a boiler is shut down.	The provisions are essentially the same.
503.4.4 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.	**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	The provisions are somewhat similar.

2009 IECC	Standard 90.1-07	Comparative Notes
	equipment *efficiency* ratings listed in Tables 6.8.1A through 6.8.1D.	
503.4.4 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.	**6.5.5.2 Fan Speed Control** Each fan powered by a motor of 7.5 hp 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.	The provisions are the same.
Exception: Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables 503.2.3(6) and 503.2.3(7).	**Exception to 6.5.5.2** a. Condenser fans serving multiple refrigerant circuits. b. Condenser fans serving flooded condensers. c. Installations located in climate zones 1 and 2. d. Up to one-third of the fans on a condenser or tower with multiple fans, where the lead fans comply with the speed control requirement.	Standard 90.1-07 has more exceptions than does the 2009 IECC and, as such, the latter could be considered more stringent than the former.
503.4.5 Requirements for complex mechanical systems serving multiple zones. Sections 503.4.5.1 through 503.4.5.3 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*.	**6.5.2 Simultaneous Heating and Cooling Limitation** **6.5.2.1 Zone Controls.** *Zone* thermostatic controls shall be capable of operating in sequence the supply of heating and cooling energy to the *zone*. Such controls shall prevent 1. *reheating*, 2. *recooling*, 3. 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 systems, and 4. other simultaneous operation of heating and cooling systems to the same *zone*.	The provisions are basically the same. Exception: a 5-inch Standard 90.1-07 is problematic but necessary. Sometimes reheating more at a single climate zone can drastically reduce the percentage of outdoor air for the entire system, saving lots of energy. The 2009 IECC does not have a provision for this and, as such, could be considered less stringent than Standard 90.1-07.
Exception: The following define when individual zones or when entire air distribution systems are exempted from the requirement for	**Exceptions:** a. *Zones* for which the volume of air that is reheated, recooled, or mixed is no greater than the	

2009 IECC	Standard 90.1-07	Comparative Notes
VAV control: 1. Zones 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 airflowrate. 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 *zone*(s) 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.	larger of the following: 1. the volume of *outdoor air* required to meet the ventilation requirements of Section 6.2 of Standard 62.1 for the *zone*, 2. 0.4 cfm/ft2 of the *zone* conditioned floor area, 3. 30% of the zone design peak supply rate, 4. 300 cfm—this exception is for zones whose peak flow rate totals no more than 10% of the total fan system flow rate, or 5. 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 for the system. b. *Zones* where special pressurization relationships, cross-contamination requirements, or code-required minimum circulation rates are such that VAV systems are impractical. c. *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.*	
503.4.5.1 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.		This is covered by Section 6.5.2 in Standard 90.1-07 and, as such, the documents could be considered compatible.
503.4.5.2 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		This is covered by Section 6.5.2 in Standard 90.1-07 and, as such, the documents could be considered compatible.

2009 IECC	Standard 90.1-07	Comparative Notes
to a minimum before mixing of air from the other duct takes place.		
503.4.5.3 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.		This is covered by Section 6.5.1 in Standard 90.1-07 and, as such, the documents could be considered compatible.
503.4.5.4 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. 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.	**(from proposed addenda to 90.1-07) 6.5.3.3 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 percent of the difference between the design supply-air temperature and the design room air temperature. Controls that adjust the reset 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 temperature. **Exceptions:** 1. Climate zones 1a, 2a, and 3a 2. Systems that prevent re-heating, re-cooling, or mixing of heated and cooled supply air. 3. Systems in which at least 75 percent of the energy for reheating (on an annual basis) is from site recovered or site solar energy sources.	The text in the 2009 IECC is similar to that in the addenda to Standard 90.1-07.
503.4.6 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 water-cooled systems exceeds 6,000,000 Btu/hr of heat rejection, and the design service water heating load exceeds 1,000,000 Btu/h. The required heat recovery system shall have the	**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	The text in both documents is the same.

2009 IECC	Standard 90.1-07	Comparative Notes
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).	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: 1. Facilities that employ condenser heat recovery for space heating or reheat purposes with a heat recovery 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.	**Exceptions to 6.5.6.2.2** a. Facilities that employ condenser heat recovery for space 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.	The text in both documents is the same.
503.2.6 Energy recovery ventilation systems. Individual fan systems that have both a design supply air capacity of 5,000 cfm (2.36 m^3/s) or greater and a minimum outside air supply of 70 percent or greater of the design supply air quantity shall have an energy recovery system that provides a change in the enthalpy of the outdoor air supply of 50 percent or more of the difference between the outdoor air and return air at design conditions. Provision shall be made to bypass or control the energy recovery system to permit cooling with outdoor air where cooling with outdoor air is required. **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	**6.5.7.1 Kitchen Hoods.** Individual kitchen exhaust hoods larger than 5000 cfm shall be provided with makeup air sized for at least 50% of exhaust air volume that is a. unheated or heated to no more than 60°F and b. uncooled or cooled without the use of mechanical cooling. **Exception:** a. Where hoods are used to exhaust ventilation air that would otherwise exfiltrate or be exhausted by other fan systems. b. Certified grease extractor hoods that require a face velocity no greater than 60 fpm.	There are no specific parallel provisions in the 2009 IECC, although the issue of kitchen hood ventilation and exhaust rates are addressed in the International Mechanical Code. It is possible Section 503.2.6 of the 2009 IECC could be considered applicable to such systems and, as such, the documents could be considered comparable.

2009 IECC	Standard 90.1-07	Comparative Notes
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) below room setpoint, cooled to no cooler than 3°F (1.7°C) above room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control. 3. Systems serving spaces that are not cooled and are heated to less than 60°F (15.5°C). 4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy. 5. Heating systems in climates with less than 3,600 HDD. 6. Cooling systems in climates with a 1-percent cooling design wet-bulb temperature less than 64°F (18°C). 7. Systems requiring dehumidification that employ series-style energy recovery coils wrapped around the cooling coil.		
	6.5.7.2 Fume Hoods. Buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm shall include at least one of the following features: a. VAV hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50% or less of design values. b. Direct makeup (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2°F below room setpoint, cooled to no cooler than 3°F above room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control. c. Heat recovery systems to precondition makeup air from fume hood exhaust in accordance with Section 6.5.6.1, Exhaust Air Energy	The 2009 IECC in Section 503.2.6 goes down to 5,000 cfm instead of 15,000 cfm, like Standard 90.1-07, so the 2009 IECC is more stringent.

2009 IECC	Standard 90.1-07	Comparative Notes
	Recovery, without using any exception.	
503.2.11 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 is required for unenclosed spaces. **Exception:** Loading docks equipped with air curtains.	The provisions appear to be comparable.
	6.5.8.2 Heating Enclosed Spaces. Radiant heating systems that are used as primary or supplemental enclosed space heating must be in conformance with the governing provisions of the standard, including, but not limited to, the following: a. Radiant hydronic ceiling or floor panels (used for heating or cooling). b. Combination or hybrid systems incorporating radiant heating (or cooling) panels. c. Radiant heating (or cooling) panels used in conjunction with other systems such as VAV or thermal storage systems.	Similar provisions are not found in the 2009 IECC, although a review of the provisions from Standard 90.1-07 indicate the provisions for radiant systems appear to be more informative.
	6.7.1 General. The *Authority having jurisdiction* may require submittal of compliance documentation and supplemental information in accord with Section 4.2.2 of this standard.	The language in Standard 90.1-07 is permissive and, as such, is not a mandatory requirement. That said, it is not clear whether the drawings and completion records are made available to the building owner or if they will be used and affect building operation and maintenance.
	6.7.2 Completion Requirements. The following requirements are mandatory provisions and are necessary for compliance with the standard.	
	6.7.2.1 Drawings. 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 and performance data on each piece of equipment, general configuration of duct and pipe distribution system	

2009 IECC	Standard 90.1-07	Comparative Notes
	including sizes, and the terminal air or water design flow rates.	
503.2.9.3 Manuals. The construction documents shall require that an operating and maintenance manual be provided to the building owner by the mechanical contractor. The manual shall include, at least, the following: 1. Equipment capacity (input and output) and required maintenance actions. 2. Equipment operation and maintenance manuals. 3. HVAC system control maintenance and calibration 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 programming comments. 4. A complete written narrative of how each system is intended to operate.	**6.7.2.2 Manuals.** Construction documents shall require that an operating manual and a 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 be in accordance with industry-accepted standards (see Informative Appendix E) and shall include, at a minimum, the following: a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance. b. 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. c. Names and addresses of at least one *service agency*. d. HVAC controls system maintenance and calibration 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 programming comments. e. A complete narrative of how each system is intended to operate, including suggested setpoints.	The text of both documents appears to be comparable.
	6.7.2.3.1 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	The 2009 IECC does not contain comparable provisions. It could be assumed that in the absence of required testing and balancing, all else being equal, that a building constructed to Standard 90.1-07 would be more likely to operate more efficiently at initial occupancy than one built to the 2009 IECC.

2009 IECC	Standard 90.1-07	Comparative Notes
	building owner for HVAC systems serving *zones* with a total conditioned area exceeding 5000 ft^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 semi-heated spaces, detailed instructions for commissioning HVAC systems (see Informative Appendix E) shall be provided by the designer in plans and specifications.	The 2009 IECC does not contain comparable provisions. It could be assumed that in the absence of required commissioning, all else being equal, that a building constructed to Standard 90.1-07 would be more likely to operate more efficiently at initial occupancy than one built to the 2009 IECC.
SECTION 504 SERVICE WATER HEATING (Mandatory)		
	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 *manufacturers'* published sizing guidelines or generally accepted engineering standards and handbooks acceptable to the *adopting authority* (e.g., *ASHRAE Handbook—HVAC Applications*).	The 2009 IECC has no such provision but Standard 90.1-07, in having one, does not have a sizing limitation, requiring the use of the calculated loads, so this appears to be moot.
504.1 General. This section covers the minimum efficiency of, and controls for, service water-heating equipment and insulation of service hot water piping.		
504.2 Service water-heating equipment performance efficiency. Water-heating equipment and hot water storage tanks shall meet the requirements of Table 504.2. 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 potable 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.	A comparison of the tables indicates that the 2009 IECC requirements are more stringent.
No corresponding exception	**Exception to 7.4.2** All water heaters and hot-water supply boilers having more than 140 gal of storage capacity are not required to meet	The absence of the exception in the 2009 IECC would suggest it would be more stringent than Standard 90.1-07 in certain situations covered

2009 IECC	Standard 90.1-07	Comparative Notes
	the *standby loss* (SL) requirements of Table 7.8 when a. the tank surface is thermally insulated to R-12.5, b. a standing pilot light is not installed, and c. gas- or oil-fired storage water heaters have a flue damper or fan-assisted combustion.	by the exception.
504.3 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. **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.
	Exception to 7.4.4.1 When the *manufacturers'* installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion.	This type of exception would be inherently covered in the ICC codes because where the ICC codes would require something that would void the listing of the equipment, the listing would typically preempt the code.
	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 2009 IECC does not contain a comparable provision and could therefore be considered less stringent than Standard 90.1-07.
504.4 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 a nonrecirculating system 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	The text in both documents seems compatible.

2009 IECC	Standard 90.1-07	Comparative Notes
	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.	
504.5 Pipe insulation. For automatic-circulating hot water systems, piping shall be insulated with 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 noncirculating systems served by equipment without integral heat traps shall be insulated with 0.5 inch (12.7 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).	**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 a nonrecirculating storage *system* d. pipes that are externally heated (such as heat trace or impedance heating)	The requirements in both documents are about the same.
504.6 Hot water system controls. Automatic-circulating hot water system pumps or heat trace shall be arranged to be conveniently turned off automatically or manually when the hot water system is not in operation.	**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 text in both documents seems compatible.
504.7 Pools. Pools shall be provided with energy conserving measures in accordance with Sections 504.7.1 through 504.7.3.	**7.4.5 Pools**	The pool provisions are essentially the same in both documents.
504.7.1 Pool heaters. All 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 or LPG shall not have continuously 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 provisions in both documents, applicable to pools, are the same.
504.7.2 Time switches. Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.	**7.4.5.3 Time Switches.** Time switches shall be installed on swimming pool heaters and pumps.	

2009 IECC	Standard 90.1-07	Comparative Notes
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.	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*.	
504.7.3 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 (32°C) shall have a pool cover with a minimum insulation value of R-12.	**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 percent of the energy for heating from site-recovered energy or solar energy source.	**Exception to 7.4.5.2** Pools deriving over 60% of the energy for heating from *site-recovered energy* or *solar energy source.*	
	7.7.1 General. The *authority having jurisdiction* may require submittal of compliance documentation and supplemental information, in accord with Section 4.2.2 of this standard.	
SECTION 505 ELECTRICAL POWER AND LIGHTING SYSTEMS (Mandatory)		
	8.4.1 Voltage drop. Feeders and branch circuits have a limitation on voltage drop that is not in the IECC.	Standard 90.1-07 regulates voltage drop in feeders and branch circuits while the 2009 IECC does not. The former could be more energy-conserving than the latter to the degree that the former affected improvements in these items over what happens in the field in the absence of any limitations on voltage drop. The *National Electrical Code, 2005 Edition,* Quincy, MA, FPN 4 to rule 210.19 limits voltage drop from the electrical box to the outlet or connection to 5%, which is consistent with the 2% + 3% in Standard 90.1-07. The 2009 IECC does not likely have this provision because it is covered in the ICC adoption of the NEC by reference.
505.1 General (Mandatory). This section covers lighting system controls, the connection of ballasts, the maximum lighting power for interior applications and minimum acceptable lighting equipment for exterior applications.	**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,	Both documents appear to have the same scope, although Standard 90.1-07 does apply to building grounds lighting, which is not specifically called out in the 2009 IECC. A further clarification on this can be based on a subsequent comparison

2009 IECC	Standard 90.1-07	Comparative Notes
	and illuminated canopies c. exterior building grounds lighting provided through the *building*'s electrical *service*	of the technical requirements for exterior lighting, below. The 2009 IECC does include similar sections for exterior lighting requirements, including efficacy as well as lighting power density (LPD) limits, which are similar and often the same as Standard 90.1-07, so even though not stated the same in the scope section, both documents do cover exterior lighting.
Exception: Lighting within dwelling units where 50 percent or more of the permanently installed interior light fixtures are fitted with high-efficacy lamps. **505.5.1 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 505.5.1.1 through 505.5.1.4. **Exceptions:** 1.3. Emergency lighting automatically off during normal building operation. 11. Lighting *approved* because of safety or emergency considerations, inclusive of exit lights.	**Exceptions to 9.1.1** 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, or regulation d. decorative gas lighting systems	The 2009 IECC appears to be more stringent than Standard 90.1-07 in that it does not exempt dwelling-unit lighting unless half of the lighting in the dwelling unit is high-efficiency lighting. Both documents appear the same as related to emergency lighting and for safety and health.
101.4.3 Additions, alterations, renovations or repairs. Additions, alterations, renovations or repairs to an 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	**9.1.2 Lighting Alterations.** The replacement of lighting *systems* in any building space shall comply with the *LPD* requirements of Section 9 applicable to that space. New lighting *systems* shall comply with the applicable *LPD* requirements of Section 9. Any new *control devices* as a direct replacement of existing *control devices* shall comply with the specific requirements of Section 9.4.1.2(b). **Exception:** *Alterations* that replace less than 50% of the *luminaires* in a *space* need not comply with these requirements provided that such	The scopes of both documents are the same regarding replacement lighting systems. Standard 90.1-07 does not have an exception for replacement of only bulbs and ballasts within existing luminaries. It is not likely, however, that Standard 90.1-07 would be applied if, for instance, a bulb and ballast was being replaced in an existing luminaire.

2009 IECC	Standard 90.1-07	Comparative Notes
as a single building. **Exception:** The following need not comply provided the energy use of the building is not increased: 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.	*alterations* do not increase the installed interior lighting power.	
505.5.1.1 Screw lamp holders. The wattage shall be the maximum *labeled* wattage of the luminaire. **505.5.1.2 Low-voltage lighting.** The wattage shall be the specified wattage of the transformer supplying the system. **505.5.1.3 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. **505.5.1.4 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.	**9.1.3 Installed Interior Lighting Power.** The *installed interior lighting power* shall include all power used by the *luminaires*, including *lamps*, *ballasts*, *transformers*, and *control devices* except as specifically exempted in Section 9.2.2.3. **Exception:** If two or more independently operating lighting systems in a space are capable of being controlled to prevent simultaneous user operation, the installed interior lighting power shall be based solely on the lighting system with the highest wattage. *Section 9.1.4 also covers the issue of luminare voltage and is discussed and compared below.*	The items covered in both documents seem to be comparable. Standard 90.1-07 would allow, however, two systems that in the aggregate could exceed the allowable lighting budget as long as they were independently controlled, so they could not function at the same time. The 2009 IECC does not appear to allow such multiple lighting systems. As such, it could be concluded that the 2009 IECC could be more stringent on the basis that it would not be possible to exceed the allowable lighting load, whereas in Standard 90.1-07, it could be if someone later disconnected the required controls. Note that with either document one can add more lighting fixtures after occupancy if they do not take out a permit.
505.2.1 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.	**9.4.1.2 Space Control.** Each space enclosed 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. a. A control device shall be	The provisions are not identical. The 2009 IECC refers to walls and partitions while Standard 90.1-07 refers to partitions. The term "partition" has a specific meaning in the ICC codes and it is likely that Standard 90.1-07 intended to include walls but, technically, they are not mentioned. The provisions of Standard 90.1-07 are more robust as

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Exceptions: 1. Areas designated as security or emergency areas that must be continuously lighted. 2. Lighting in stairways or corridors that are elements of the means of egress.	installed that automatically turns lighting off within 30 minutes of all occupants leaving a space, except spaces with multi-scene control, in 1. classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms), 2. conference/meeting rooms, and 3. employee lunch and break rooms. These spaces are not required to be connected to other automatic lighting shutoff controls. b. For all other spaces, each *control device* shall be activated either manually by an occupant or automatically by sensing an occupant. Each *control device* shall *control* a maximum of 2500 ft^2 area for a space 10,000 ft^2 or less and a maximum of 10,000 ft^2 area for a space greater than 10,000 ft^2 and be capable of overriding any time-of-day scheduled shutoff *control* for no more than four hours. **Exception:** Remote location shall be permitted for reasons of safety or security when the remote control device has an indicator pilot light as part of or next to the control device and the light is clearly labeled to identify the controlled lighting.	they relate to the capabilities of the controls, but there are other provisions in the 2009 IECC that address control provisions that may be relevant and are addressed below.
505.2.2 Additional controls. Each area that is required to have a manual control shall have additional controls that meet the requirements of Sections 505.2.2.1 and 505.2.2.2.		
505.2.2.1 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. 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		The 2009 IECC requires bi-level manual switching (subject to exceptions) based on the idea that, in general, the presence of bi-level controls will allow the occupant use of the controls for energy savings. Standard 90.1-07 does not have this requirement, instead preferring to require automatic controls.

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luminaires or alternate lamps; 3. Switching the middle lamp luminaires independently of the outer lamps; or 4. Switching each luminaire or each lamp.		
Exceptions: 1. Areas that have only one luminaire. 2. Areas that are controlled by an occupant-sensing device. 3. Corridors, storerooms, restrooms or public lobbies. 4. *Sleeping unit* (see Section 505.2.3). 5. Spaces that use less than 0.6 watts per square foot (6.5 W/m^2).		
505.2.2.2 Automatic lighting shutoff. Buildings larger than 5,000 square feet (465m^2) shall be equipped with an automatic control device to shut off lighting in those areas. This automatic control device shall function on either:	**9.4.1.1 Automatic Lighting Shutoff.** Interior lighting in *buildings* larger than 5000 ft^2 shall be controlled with an *automatic control device* to shut off *building* lighting in all spaces. This *automatic control device* shall function on either	The provisions appear to be the same.
1. A scheduled basis, using time-of-day, with an independent program schedule that controls the interior lighting in areas that do not exceed 25,000 square feet (2323 m^2) and are not more than one floor; or	a. a scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times—an independent program schedule shall be provided for areas of no more than 25,000 ft^2 but not more than one floor—or	The provisions appear to be the same.
2. An occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space; or	b. an *occupant sensor* that shall turn lighting off within 30 minutes of an occupant leaving a space or	The provisions appear to be the same.
3. A signal from another control or alarm system that indicates the area is unoccupied.	c. a signal from another control or alarm system that indicates the area is unoccupied.	The provisions appear to be the same.
Exception: The following shall not require an automatic control device: 1. *Sleeping unit* (see Section 505.2.3). 2. Lighting in spaces where patient care is directly provided. 3. Spaces where an automatic shutoff would endanger occupant safety or security.	**Exceptions:**The following shall not require an *automatic control device:* a. Lighting intended for 24-hour operation. b. Lighting in spaces where patient care is rendered. c. Lighting in spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).	The provisions appear to be the same, with the exception that the 2009 IECC exempts sleeping units and Standard 90.1-07 exempts lighting intended for 24-hour operation. In the case of the former, Standard 90.1-07 could be considered more stringent. In the case of the latter, the 2009 IECC could be considered more stringent in that it would not exempt lighting intended for a 24-hour operation

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		(although if such a situation occurred it is logical that the permitee could request a variance in that automatic controls to turn off lighting intended to operate continuously were not feasible).
505.2.2.2.1 Occupant override. Where an automatic time switch control device is installed to comply with Section 505.2.2.2, Item 1, it shall incorporate an override switching device that: 1. Is readily *accessible*. 2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated. 3. Is manually operated. 4. Allows the lighting to remain on for no more than 2 hours when an override is initiated. 5. Controls an area not exceeding 5,000 square feet (465 m^2).	**9.4.1.2 Space Control.** Each space enclosed 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. a. A control device shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space, except spaces with multi-scene control, in 1. classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms), 2. conference/meeting rooms, and 3. employee lunch and break rooms. These spaces are not required to be connected to other automatic lighting shutoff controls. b. For all other spaces, each *control device* shall be activatedeither manually by an occupant or automatically by sensing an occupant. Each *control device* shall *control* a maximum of 2500 ft2 area for a space 10,000 ft2 or less and a maximum of 10,000 ft2 area for a space greater than 10,000 ft2 and be capable of overriding any time-of-day scheduled shutoff control for no more than 4 hours.	The controls override provisions appear to be the same with some exceptions. The 2009 IECC provides for a 2-hour override and Standard 90.1-07 provides for a 4-hour override. The 2009 IECC specifies the area of control at 5,000 sq. ft. Standard 90.1-07 has a two-step scale for override area; 1,500 sq. ft. and 10,000 sq. ft. if the building is over 10,000 sq. ft. in size. Also, the 2009 IECC allows for exemptions in certain large spaces.
Exceptions: 1. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, where captive-key override is utilized, override time shall be permitted to exceed 2 hours. 2. In malls and arcades,		

2009 IECC	Standard 90.1-07	Comparative Notes
auditoriums, single-tenant retail spaces, industrial facilities and arenas, the area controlled shall not exceed 20,000 square feet (1860 m^2).		
505.2.2.2.2 Holiday scheduling. If an automatic time switch control device is installed in accordance with Section 505.2.2.2, Item 1, it shall incorporate an automatic holiday scheduling feature that turns off all loads for at least 24 hours, then resumes the normally scheduled operation.		
Exception: Retail stores and associated malls, restaurants, grocery stores, places of religious worship and theaters.		
505.2.2.3 Daylight zone control. Daylight zones, as defined by this code, shall be provided with individual controls that control the lights independent of general area lighting. 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.		The 2009 IECC provides for control in specified daylighting-capable climate zones but does not require this to be automatic. Control may be manual and left to the use of the occupant.
Exception: Daylight spaces 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.		
505.2.4 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	**9.4.1.3 Exterior Lighting Control.** Lighting for all exterior applications not exempted in Section 9.1 shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours. Lighting not designated for dusk-to-dawn operation shall be controlled by either	The provisions in both documents are comparable, although Standard 90.1-07 has an exception for vehicle entrances or exits where safety and security is an issue. One might argue, however, that such lighting would be designated for dawn-to-dusk operation and, as such, would not be within the scope of the code anyway and therefore indirectly exempt (or not in need of an

2009 IECC	Standard 90.1-07	Comparative Notes
and the time setting during loss of power for a period of at least 10 hours.	a. a combination of a photosensor and a time switch or b. 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 ten hours. **Exceptions** Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.	exemption).
505.3 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.	**9.4.2 Tandem Wiring.** Luminaires designed for use with one or three linear fluorescent lamps greater than 30 W each shall use two-lamp tandem-wired ballasts in place of single-lamp ballasts when two or more luminaires are in the same space and on the same control device. Exceptions to 9.4.2. a. Recessed luminaires more than 10 ft. apart measured center to center. b. Surface-mounted or pendant luminaires that are not continuous. c. Luminaires using single-lamp high-frequency electronic ballasts. d. Luminaires using three-lamp high-frequency electronic or three-lamp electromagnetic ballasts. e. Luminaires on emergency circuits. f. Luminaires with no available pair.	The provisions are essentially the same except the 2009 IECC does not have a limit on lamp wattage, while Standard 90.1-07 does. As such, lamps 30W or less would be covered by the 2009 IECC but not by Standard 90.1-07.
505.4 Exit signs (Mandatory). Internally illuminated exit signs shall not exceed 5 watts per side.	**9.4.3 Exit Signs.** Internally illuminated exit signs shall not exceed 5 W per face.	The provisions are the same.
505.5 Interior lighting power requirements (Prescriptive). A building complies with this section if		

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its total connected lighting power calculated under Section 505.5.1 is no greater than the interior lighting power calculated under Section 505.5.2.		
505.5.1 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 505.5.1.1 through 505.5.1.4.	**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.	The 2009 IECC has one path for interior lighting compliance−the building area method covered in Section 9.5 of Standard 90.1-07. Because the 2009 IECC references Standard 90.1-07, one can choose to use the Space-by-Space method in the standard; on that issue the documents would be identical.
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. 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	**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 in accordance with Section 9.1.3. However, any such lighting shall not be exempt 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 medical or dental procedures and lighting integral to medical *equipment*. d. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.	A comparison of the two lists of exceptions finds the following differences: • Professional sports-playing areas are not exempted by Standard 90.1-07 (although both documents limit the load in sports arenas to 1.1 wsf). Note that Standard 90.1-07 does exempt lighting for television broadcasting in sporting-activity areas. • Lighting in *sleeping units* in hotels, motels, etc., is exempt in the 2009 IECC. Standard 90.1-07 in Section 9.1.1 exception b exempts lighting in dwelling units which, based on definition, would typically occur only in apartments, condominiums, and other high-rise residential buildings (not hotels and motels). • Emergency lighting that is normally off during business hours is exempt in

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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.	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 9.4.1.4(d).	Standard 90.1-07 in Section 9.1.1, exception a. Lighting that is off during business hours is typically emergency circuit lighting on battery or other generator systems and is therefore typically not counted as part of LPD compliance. • The 2009 IECC exempts lighting for photographic processes and Standard 90.1-2007 does not. These differences could be considered minor.
505.5.1.1 Screw lamp holders. The wattage shall be the maximum *labeled* wattage of the luminaire.	**9.1.4 (a)** The wattage of incandescent or tungsten-halogen luminaires with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.	The provisions appear to be the same.
505.5.1.2 Low-voltage lighting. The wattage shall be the specified wattage of the transformer supplying the system.	**9.1.4 (d)** The wattage of low-voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow the addition and/or relocation of luminaires	The provisions appear to be the same.

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	without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.	
505.5.1.3 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 (e)** The wattage of all other miscellaneous lighting equipment shall be the specified wattage of the lighting equipment.	The provisions appear to be the same.
505.5.1.4 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 (c)** 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 appear to be the same.
505.5.1.3 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 (b)** The wattage of luminaires with permanently installed or remote ballasts or *transformer*s shall be the operating input wattage of the maximum lamp/auxiliary combination based on values from the auxiliary *manufacturers'* literature or recognized testing laboratories or shall be the maximum labeled wattage of the luminaire.	Standard 90.1-07 has 4 specific conditions for determining luminaire wattage and then a miscellaneous catch-all 5th condition. The 2009 IECC appears to have 3 specific conditions and then one additional catch-all for miscellaneous luminaires. That miscellaneous provision in the 2009 IECC would logically be applied to the one specifically listed in Standard 90.1-07, but not specifically listed in the 2009 IECC. Application of the 2009 IECC provisions would appear to be equivalent to those in Standard 90.1-07 for the luminaires in question.
505.5.2 Interior lighting power. The total interior lighting power (watts) is the sum of all interior lighting powers for all areas in the building covered in this permit. The interior lighting power is the floor area for each building area type listed in Table 505.5.2 times the value from Table 505.5.2 for that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that	**9.5.1 Building Area Method of Calculating Interior Lighting Power Allowance.** Use the following steps to determine the interior lighting power allowance by the Building Area Method: a. Determine the appropriate building area type from Table 9.5.1 and the allowed *LPD* (watts per unit area) from the "Building Area Method" column. For building area types	The calculation approach for lighting power density and the limits given by building area type are the same in both documents. There is also an additional lighting power allowance for retail areas that is included in the 2009 IECC (i.e., building area type) method, but this is not available when using the Standard 90.1-07 Building Area method and only allowed when using the Standard 90.1-07 space-type method (Section

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accommodate or are associated with a single building area type as *listed* in Table 505.5.2. When this method is used to calculate the total interior lighting power for an entire building, each building area type shall be treated as a separate area.	not listed, selection of a reasonably equivalent type shall be permitted. b. Determine the gross lighted floor area (square feet) of the building area type.	9.6.2). The differences in application, depending on which method is chosen on a national compliance average, are not quantifiable.
505.6 Exterior lighting. (Mandatory). When 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 505.6.1 and 505.6.2.		A parallel provision does not appear in Standard 90.1-07. As such, one might argue that all exterior lighting, regardless of the source of electric power, is covered by the standard and, as such, Standard 90.1-07 could be considered more stringent because it covers some lighting that might not be covered by the 2009 IECC.
Exception: Where *approved* because of historical, safety, signage or emergency considerations.		This is similar to the Standard 90.1-07 exception in Section 9.4.5.
505.6.1 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 505.6.2.	**9.4.4 Exterior Building Grounds Lighting.** All exterior building grounds luminaires that operate at greater than 100 W shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Section 9.1.1 or 9.4.5.	The provisions appear to be the same.
505.6.2 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 505.6.2(2) for the applicable lighting *zone*. Tradeoffs are allowed only among exterior lighting applications listed in Table 505.6.2(2), Tradable Surfaces section. The lighting zone for the building exterior is determined from Table 505.6.2(1) unless otherwise specified by the local jurisdiction. Exterior lighting for all applications (except those included in the exceptions to Section 505.6.2) shall comply with the requirements of Section 505.6.1.	**9.4.5 Exterior Building Lighting Power.** The total *exterior lighting power allowance* for all exterior building applications is the sum of the individual lighting power densities permitted in Table 9.4.5 for these applications plus an additional unrestricted allowance of 5% of that sum. Trade-offs are allowed only among exterior lighting applications listed in the Table 9.4.5 "Tradable Surfaces" section.	Provisions appear to be the same when comparing the power density limits.
Exceptions: Lighting used for the following exterior applications is	**Exceptions:** Lighting used for the following exterior applications is	The provisions appear to be the same.

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exempt when equipped with a control device independent of the control of the nonexempt lighting: 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.	exempt when equipped with a *control device* 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. 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.*	
505.2.3 Sleeping unit controls. *Sleeping unit*s in hotels, motels, boarding houses or similar buildings shall have at least one master switch at the main entry door that controls all permanently wired luminaires and switched receptacles, except those in the bathroom(s). Suites shall have a control meeting these requirements at the entry to each room or at the primary entry to the suite.	**9.4.1.4 Additional Control** 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. *Hotel and Motel Guest Room Lighting*—hotel and motel guest rooms and guest suites shall have a master *control device* at the main room entry that *controls* all *permanently installed luminaires* and switched receptacles. d. *Task Lighting*—supplemental 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	The 2009 IECC does not appear to have provisions to match all those in Standard 90.1-07. The provisions applicable to sleeping units in hotels and motels seem to be comparable. For the other conditions in Standard 90.1-07 one could make a point that such controls could be addressed by the NEC already. In any event, it is possible that a building having the conditions outlined here in Standard 90.1-07, with the exception of the sleeping room lighting in hotels and motels, would have such controls under Standard 90.1-07 and not under the 2009 IECC. Beyond that, the energy savings is still achieved only if the required switching is actually used after occupancy.

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	nonvisual applications, such as plant growth and food warming, shall have a separate *control device*. f. *Demonstration Lighting—lighting equipment* that is for sale or for demonstrations in lighting education shall have a separate *control device*.	
505.7 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.		Standard 90.1-07 does not contain a provision for individual metering. The degree to which individual meters to dwelling units foster conservation of energy by occupants, it is possible that the 2009 IECC could be considered more energy-conserving than Standard 90.1-07 with respect to this issue.

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techsupport@becp.pnl.gov
www.energycodes.gov/support/helpdesk.php

EERE Information Center
1-877-EERE-INF (1-877-337-3463)
www.eere.energy.gov/informationcenter

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