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COMPARING THE COMMERCIAL PROVISIONS OF THE 2015 IECC WITH THE CORRESPONDING PROVISIONS IN THE 2012 IECC FOR COMMERCIAL CONSTRUCTION IN TEXAS

A Report

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EXECUTIVE SUMMARY

The purpose of this analysis was to determine the stringency of commercial provisions in the 2015 IECC when compared to the corresponding provisions in the 2012 IECC for commercial buildings in Texas. In order to perform the assessment, the mandatory, prescriptive and performance commercial provisions were compared.

In order to perform the assessment, this analysis compares the commercial provisions in the 2012 IECC, and the 2015 IECC. A qualitative analysis was performed comparing all the sections in Chapter 4[CE] of the 2012 IECC and Chapter 4 [CE] of the 2015 IECC. The analysis categorizes the impact of these changes in terms of stringency over the 2012 code. No attempt has been made to provide a quantitative assessment using whole-building simulation. Hence, certain provisions in the 2015 code could not be assessed and have been identified as such.

When comparing the requirements in Section C401 of the 2015 IECC with Section C401 of the 2012 IECC for ‘General’ requirements, it was concluded:

- To demonstrate compliance with the first path provided in the code, it was now required to comply with the provisions in the ASHRAE Standard 90.1-2013.
- Compliance for existing buildings is now provided in Chapter 5[CE] of the 2015 IECC.

When comparing the requirements in Section C402 of the 2015 IECC with Section C402 of the 2012 IECC for ‘Building Envelope Requirements’, the 2015 code demonstrated:

- Improved specifications for opaque building components.
- Improved specifications for fenestration.
- Expanded requirements to calculate U-factors of walls with cold-formed steel, aged roof reflectance and provisions for rooms containing fuel burning appliances.

When comparing the requirements in Section C403 of the 2015 IECC with Section C403 of the 2012 IECC for ‘Building Mechanical Systems’, the 2015 code demonstrated:

- Improved efficiency requirements for HVAC equipment performance.
- Added efficiency requirements for air-conditioning units serving computer rooms.
- Added specifications for commercial refrigeration equipment.
- Elaborated and added provisions for HVAC system controls which include: requirement for zone isolation; and requirement of economizer fault detection.
- Added specifications for hot water boiler outdoor temperature setback control.
- Updated provisions for energy recovery ventilation systems whose requirements are now based on the number of hour’s ventilations systems operate.
- Introduced specifications for kitchen exhaust systems.
- Updated requirements for duct and plenum insulation and sealing.
- Introduced fan efficiency requirements.
- Updated provisions for air and water economizers, which include added requirements for the efficient operation of these systems.
- Updated provisions for complex mechanical systems serving multiple zones, which include updated specifications for fan controls, heat rejection equipment and hot gas bypass limitations.

When comparing the requirements in Section C404 of the 2015 IECC with Section C404 of the 2012 IECC for ‘Service Water Heating’, the 2015 code demonstrated:

- Improved specifications for certain categories of service hot water systems.
- Improved specification for insulation of piping.
- Improved specifications for energy consumption of pools and permanent spas.

- Added information for implementation of efficient heated water supply piping, heated water circulating and temperature maintenance system, demand recirculation controls, drain water heat recovery systems and energy requirements of portable spas.
- Added commissioning requirements for hot water systems.

When comparing the requirements in Section C405 of the 2015 IECC with Section C405 of the 2012 IECC for ‘Electric Power and Lighting Systems’, the 2015 code demonstrated:

- Elaborate provisions for lighting controls, which include the added requirement of occupant sensor controls.
- Elaborate provisions for daylight responsive controls.
- Improved specifications for permissible lighting power densities for different building area types.
- Improved specifications for non-tradable components of exterior lighting.
- Added requirements for electric transformers, electric motors as well as vertical and horizontal transportation system and equipment.

Section C406 for ‘Additional Efficiency Package Options’ has been updated in the 2015 IECC. Requirements of this section have been subdivided into the following categories: more efficient HVAC equipment performance; reduced lighting power density; enhanced digital lighting controls; on-site renewable energy; dedicated outdoor air system; and reduced energy use in service water system.

Section C407 for ‘Total Building Performance’ has been updated in the 2015 IECC. Not many changes have been made in this section of the 2015 code. However, since this sections of the code references other sections which are more stringent, it can be concluded that compliance with this section is more stringent.

Section C408 for ‘System Commissioning’ has been updated in the 2015 IECC. New requirements have been added for lighting system functional testing, which include: occupant sensor controls, time control switches, daylight responsive controls and documentation requirements for lighting controls in construction documents.

It should be noted that several provisions in the 2015 IECC could not be assessed qualitatively. A quantitative assessment is necessary to determine the stringency of these provisions. These provisions include:

- Introducing the component performance alternative in Section 402.1.5.
- Increasing the maximum permissible area limits for skylights with the addition of daylight responsive controls in Section C402.4.1.1 and Section C402.4.1.2 respectively.
- Increasing specifications for SHGC and U-value for skylights for zones provided with daylight responsive controls in Section C402.4.2.
- Provisions for guidelines to calculate the adjustment factor for water cooled chillers in the case of chilled water temperature being different as described in Section C403.2.3.1.

It is concluded that the provisions for commercial buildings in the 2015 IECC are more stringent than the corresponding provisions in the 2012 IECC.

This report is organized in the following order:

- Section 1: Provides a brief overview of the task.
- Section 2: Describes the qualitative analysis that compares the commercial provisions in the 2015 IECC and the 2009 IECC.
- Section 3: Provides the conclusions from the study.

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1. OVERVIEW

The purpose of this analysis was to determine the stringency of residential provisions in the 2015 IECC when compared to the corresponding provisions in the 2012 IECC for commercial buildings in Texas. In order to perform the assessment, the mandatory, prescriptive and performance path provisions were compared for commercial buildings.

2. QUALITATIVE ANALYSIS COMPARING THE COMMERCIAL PROVISIONS IN THE 2015 IECC AND 2012 IECC

A qualitative assessment was performed comparing all sections of Chapter 4 (CE) of the 2015 IECC with the corresponding sections of Chapter 4 (CE) in the 2012 IECC. The findings and comments are presented in the subsections below. The findings are also summarized in Appendix A of this report. In sections where a discussion is required to provide justification to the proposed change in the 2015 IECC appropriate references are made to the documentation describing the proposed changes to the commercial provisions in the International Energy Conservation Code (ICC 2013). No attempt was made to provide a quantitative assessment of the code. In addition, a study was performed comparing all sections of the Chapter 4 (CE) of the 2015 IECC with the corresponding sections of Chapter 5 in 2009 IECC, which is the current Texas Building Energy Performance Standard (TBEPS). The findings are summarized in Appendix B.

2.1 Comparing the Provisions in Section C401¹, for ‘General’ Requirements

Similar to the 2012 IECC, the 2015 IECC provides three paths for commercial buildings to demonstrate compliance. The description of the compliance paths is provided below:

- To demonstrate compliance with the first path provided in the 2015 code, it was now required to comply with the provisions in the ASHRAE Standard 90.1-2013. A preliminary qualitative and quantitative assessment of ASHRAE Standard 90.1-2013 has been performed at the Pacific Northwest National Laboratory (Halverson et al. 2014a, 2014b). The reports conclude that the ASHRAE Standard 90.1-2013 is more stringent than the ASHRAE Standard 90.1-2010.
- To demonstrate compliance with the prescriptive path provided in the code, in addition to the prescriptive requirements in Section C402, C403, C404 and C405, it is now required to demonstrate compliance with any one of the provisions in Section C406 on additional efficiency package options. Section C406 has been updated with more stringent requirements in the 2015 IECC.
- Compliance requirements for existing buildings have now been relocated in Chapter 5[CE] of the 2015 IECC.

The additions and modifications to the requirements in this section of the 2015 IECC point to requirements that are more stringent than those in the 2012 IECC. Hence, the requirements in this section are more stringent than the corresponding requirements of the 2012 IECC.

2.2 Comparing the Provisions in Section C402 ‘Building Envelope Requirements’

According to Section C402.1 for general requirements, the 2015 IECC provides three options for building thermal envelope assemblies to comply with the code using prescriptive requirements. The opaque building thermal envelope assemblies are required to comply with the R-value based method, the U-, C- and F-factor based method, or the component performance alternative provided in the code. Changes and modifications in Section C402.1 have been described below:

¹ Sections in this report refer to the organization of information in the 2015 IECC.

- Section C402.1.1 and C402.1.2 describe buildings that are exempt from complying with the 2015 IECC. These sections have been added to support and clarify descriptions and definitions elsewhere in the code. The provisions in these sections have no impact on the stringency of the 2015 IECC over the 2012 IECC.
- In Section C402.1.3 on insulation component R-value-based method, Table C402.1.3 has now been updated with increase minimum R-value requirements for most building components. The provisions in this section increase the stringency of the 2015 IECC over the 2012 IECC.
- Similarly in Section C402.1.4 on assembly U-factor, C-factor or F-factor based methods, Table C402.1.4 has been updated to reduce the maximum U-value requirements for most building components. In addition, Section C402.1.4.2 has been added in the 2015 code to calculate the thermal resistance of cold-formed steel. The provisions in this section now address a gap in the code for calculating U-factors for steel stud wall assemblies. The provisions in this section increase the stringency of the 2015 IECC over the 2012 IECC.
- Section C402.1.5 describing the component performance alternative has been introduced in the 2015 code. The path intends to provide significant additional flexibility for design teams, allowing trade-offs for U-values of various building envelope components without requiring a full total building performance computation. A qualitative assessment cannot be used to assess the stringency of this section in the 2015 IECC over the 2012 IECC.

Section 402.2 describing specific building thermal envelope insulation requirements has been modified in the 2015 IECC. The modifications are presented in the paragraphs below:

- Additional language has been added to Section 402.2.2 describing roof assembly, Section 402.2.3 on thermal resistance of above-grade walls, Section 402.2.5 on slab-on-grade perimeter insulation, and Section C402.2.6 on insulation of radiant heating systems. The added descriptions clarify provisions in the code, which include: insulation requirements of skylight curbs; characteristics of mass walls; requirements for floor framing cavity insulation to maintain permanent contact with the underside of the subfloor decking and structural slabs; and requirements for protecting slab-on-grade insulation that extends away from the building. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.
- Language has been modified in Section C402.2.4 for floors. New exceptions have been added in the 2015 code that allow for an alternate position of floor framing cavity insulation and provision of airspace between the insulation applied to the underside of concrete floor slabs. The addition of new exceptions decrease the stringency of the 2015 IECC over the 2012 IECC.
- In addition, Section 402.2.1 on multiple layers of continuous insulation has been added in the 2015 IECC. The provisions in this sections describe the method of installation for multiple layers of continuous insulation, and specifications insulation of radiant heating systems. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.

Section C402.3 on solar roof reflectance and thermal emittance has been modified in the 2015 code. The provisions in this section require compliance for minimum roof reflectance and emittance provided in Table C402.3. The values for initial reflectance have been omitted from the Table in 2015 IECC. The section also lists certain specified types and portions of roof for which compliance is exempted. The provisions of this section of the 2015 IECC are as stringent as those in the 2012 IECC. Further modifications to this section are presented in the paragraph below:

- Section C402.3.1 describing aged roof solar reflectance has been added in the 2015 code to provide an alternate compliance for aged solar roof reflectance. The provisions in this section increase the stringency of the 2015 IECC over the 2012 IECC.

Section C402.4 on fenestration has been modified in the 2015 IECC to include: requirements for maximum permissible vertical fenestration area; minimum skylight fenestration area; provisions for

lighting controls; U-factors and SHGC requirements. Modifications to this section are presented in the descriptions below:

- Provisions in Section 402.4.1 on maximum area require the maximum fenestration area to be 30% window-to-wall area ratio, which is as stringent as the provisions in the 2012 IECC. Section C402.4.1.1 on increased vertical fenestration area with daylight responsive controls allows for an increase in maximum window-to-wall area ratio to 40% of total roof area provided certain conditions are met and daylight response controls are installed. The added provisions for buildings three or more stories above grade in the 2015 IECC make this section less stringent than the corresponding provisions in the 2012 code. Section C402.4.1.2 on increased skylight area with daylight responsive controls, allow for an increase in skylight area from 3% to 4% of total roof area provided certain conditions are met and daylight response controls are installed. The provisions in this section in the 2015 IECC are as stringent as the provisions in the 2012 IECC.
- Section C402.4.2 on minimum skylight fenestration area provides minimum requirements for skylights for certain building types and area. The 2015 IECC provides more stringent requirements for minimum floor area to qualify for the provision of skylights. An added exception for spaces not requiring skylights provides clarification to the conditions such spaces must adhere to in order to qualify as this exception. The provisions in this section increase the stringency of the 2015 IECC over the 2012 IECC.
 - Section C402.4.2.1 describes requirements for lighting controls in daylight zones under skylights. Removal of the exceptions in this section of the 2015 IECC increase the stringency of this code over the corresponding section in the 2012 IECC.
 - Section C402.4.2.2 describe specifications for a haze factor for skylights in certain situations such as offices and retail stores. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.
- Section C402.4.3 provides maximum U-factor and SHGC requirements. The section points to Table C402.3 for U-factor and SHGC specifications in the code. Table C402.3 provides the requirements for fenestration in the 2015 code, which is updated from the table for fenestration requirements in the 2012 code. The section on SHGC in the table has been expanded to provide specifications for different orientations and projection factors. The provisions in this section increase the stringency of the 2015 IECC over the 2012 IECC.
 - Section C402.4.3.1 on increased skylight SHGC now relaxes the requirements of SHGC in skylights located above daylight zones and provided with daylight responsive controls. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.
 - Section 402.4.3.2 on increased skylight U-factor outlines the requirements where exceptions may be provided for U-factors for cases where automatic daylight controls are installed. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.
 - Section C402.4.3.3 describes the provisions for dynamic glazing that have been modified in the 2015 code. The added requirement for SHGC ratios in the 2015 IECC increase the stringency of this code over the corresponding section in the 2012 IECC.
 - Section C402.4.3.4 on area-weighted U-factors allows incorporating area-weighted averages for U-values of fenestration for compliance. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.
- Section C402.4.4 describes compliance for opaque doors. The section points to relevant tables for different types of opaque doors. Since the tables referred by this section are as stringent as the corresponding provisions in the 2012 code, the provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.

Section C402.5 on air leakage has been elaborated in the 2015 IECC. The modifications to this section are discussed in the paragraphs below:

- Section C402.5.1 on air barriers requires a provision of continuous air-barriers in most climate zones. Although the provisions in both the codes are similar, the removal of exceptions for provision of air barriers in Climate Zones 1 and 3 increase the stringency of the 2015 IECC over the 2012 IECC.
 - Section C402.5.1.1 on air-barrier construction provides guidelines for air-barrier construction in order to ensure compliance with the code. Air-barriers are now required to comply with list of requirements specified in the code. The provisions of this section of the 2015 IECC are as stringent as those in the 2012 IECC.
 - Section C402.5.1.2 provides compliance options for air barriers. To comply, air-barriers can meet the provisions in Section C402.5.1.2.1 for materials or Section C402.5.1.2.2 for assemblies. The addition of masonry clay or shale materials and wall assemblies to be exempt from testing renders the 2015 IECC less stringent than the 2012 IECC.
- Section C402.5.2 on air leakage of fenestration provides maximum air infiltration rates for fenestration assemblies as outlined in Table C402.5.2. Maximum infiltration values for fenestration components provided in the 2015 code have added provisions for high-speed doors hence increase the stringency of the 2015 IECC over the 2012 IECC.
- Requirements have been added to Section C402.5.3 in the 2015 code for rooms containing fuel burning appliances. These requirements address the safety issues associated with such installations. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.
- Requirements have been reworded in Section C402.5.4 for doors and access opening to shafts, chutes, stairways and elevator lobbies that clarify the sealing requirements for such installations. The provisions in these sections do not impact the stringency of the 2015 IECC over the 2012 IECC.
- Requirements have been reworded in Section C402.5.5 for air intakes, exhaust openings, stairways and shafts. The provisions in this sections do not impact the stringency of the 2015 IECC over the 2012 IECC.
- Section C402.5.7 on vestibules has been modified to clarify exceptions for doors with installed air curtains. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.
- Section C402.5.8 on recessed lighting has been reorganized in the 2015 code in order to clarify the provisions in the code. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.

2.3 Comparing the Provisions in Section R403 'Building Mechanical Systems'

In Section C403.1 describing general provisions for building mechanical systems, new language has been added in the 2015 code for walk-in coolers, walk-in freezers, refrigerated warehouse coolers, and refrigerated freezers. The contents of this section increase the stringency of the 2015 IECC over the 2012 IECC.

Section 403.2 describes the mandatory provisions applicable to all mechanical systems. The modifications to this section are discussed in the paragraphs below:

- Section 403.2.1 describing calculation of heating and cooling loads now requires accounting for reduction in loads on implementation of energy recovery systems. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.
- Section 403.2.2 describing equipment sizing has been reorganized in the 2015 code. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.
- Current equipment has been updated with more stringent efficiency requirements in Section 403.2.3 describing HVAC equipment performance requirements. In addition, new equipment requirements describing minimum efficiency air-conditioners and condensing units serving

computer rooms has been added. The contents of this section increase the stringency of the 2015 IECC over the 2012 IECC.

- The section refers to Tables 403.2.3(1) through (10) for equipment efficiencies. Information has been updated in Tables 403.2.3(1) through (7) for more stringent specifications. In addition, new information has been added to incorporate a greater variety of equipment. Table 403.2.3(9) has been added with efficiency specifications for units serving computer rooms. Table 403.2.3(10) has been added with efficiency specifications for heat transfer equipment.
- Section C403.2.3.1 on water cooled centrifugal chilling packages has been updated from the earlier code. This section provides guidelines to calculate the adjustment factor in the case of chilled water temperatures being different. The formula is different than that specified in the 2012 code. A qualitative analysis cannot be used to determine the stringency of the equation provided in this section.
- Section 403.2.3.2 on positive displacement chilling packages provides specifications for positive displacement chilling packages in the case their operating conditions do not meet the specified requirements. This section points to Table C403.2.3(7), which has been updated in the 2015 IECC. The contents of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section C403.2.4 describing HVAC system controls modifies the provisions for thermostatic controls, off-hour controls, shut-off dampers and snow and ice melt systems. New provisions have been added for setpoint overlap restrictions for zones having separate thermostat controls, zone isolation, freeze protection system controls and economizer fault detection diagnosis.
 - An exception has been added to Section C403.2.4.1.2 describing deadbands that allows applications requiring precision in indoor temperatures not to have a deadband. The added exception of occupancies or applications requiring precision in indoor temperature control from specifications of deadbands cannot be challenged in terms of stringency as it addresses the health and safety of the occupants. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC. Section C403.2.4.1.3 describing setpoint overlap restrictions has been added for zones that have separate heating and separate cooling thermostatic control. It is now required to provide a limit switch, mechanical stop or direct digital control system with software programming to prevent the heating setpoint to exceed the cooling setpoint and maintain a deadband. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
 - Section C403.2.4.3 describing shutoff dampers has been modified to introduce specifications for motorized dampers that are provided to control the outdoor air intakes, exhaust openings, stairway and shaft vents. Specifications for gravity dampers are also provided in cases where the use of such dampers is permitted by the code. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
 - Section C403.2.4.4 describing zone isolation has now been added to the 2015 IECC. The code now requires zone isolation of certain thermal zones. The code now also requires isolation devices installed in each of these zones. The code now also requires central systems and plants to provide for the operation of isolation zones. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
 - The text in Section C403.2.4.5 describing snow and ice melt system controls has been reorganized in the 2015 code to provide better clarity to the reader. The provisions of this section do not have an impact on the stringency of the 2015 IECC over the 2012 IECC.
 - Section C403.2.4.6 describing freeze protection system controls introduces specifications for freeze protection systems such as heat tracing of outdoor pipes and heat exchangers. The provisions of these sections increase the stringency of the 2015 IECC over the 2012 IECC.

- Requirements have been introduced in Section C403.2.4.7 describing economizer fault detection and diagnostics that now require the installation of contamination sensing devices and automatic controls to stage or modulate fan airflow rates or intermittently operate fans in response to these devices. The provisions of these sections increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section 403.2.5 describing hot water boiler outdoor temperature setback control has been introduced in the code to provide requirements for outdoor temperature setback controls for hot water boilers. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section C403.2.6 describing ventilation has been modified to provide for parking garage ventilation controls as described in Section C403.2.6.2. The provisions in this section require the installation of contamination sensing devices and automatic controls to stage or modulate fan airflow rates or intermittently operate fans in response to these devices. The provisions of these section increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section C403.2.7 describing energy recovery ventilation systems has been modified in the 2015 code. The section refers to Table C403.2.7 (1) and Table C403.2.7 (2) for energy recovery requirements for ventilation systems. These tables has been added elaborating the energy recovery requirements for different % of outdoor air at full design airflow rate and climate zones. Additional conditions are added in the 2015 IECC that are exempt from installing energy recovery systems. These include systems that exhaust toxic, flammable, paint or corrosive fumes or dust and commercial kitchen hoods that are used for collecting and removing grease vapors and smoke. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section C403.2.8 describing kitchen exhaust systems has been introduced in the 2015 code. The code now provides specifications for replacement air, conditioned supply air. The section also introduces requirements for kitchen hoods that have airflow rates greater than 5,000 CFM. This section refers to Table C403.2.8 for maximum exhaust flow rates for different types of kitchen hoods. The exhaust rates are also dependent on the usage of kitchen equipment. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section C403.2.9 describing duct and plenum insulation and sealing has been updated to provide more stringent requirements for duct insulation R-value. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
 - In Section 403.2.9.1 on duct construction, Section C403.2.9.1.1 for low-pressure duct systems has been modified to exclude certain types of low pressure duct systems to be sealed as per specifications provided in this section. In Section C403.2.9.1.3 on high pressure duct systems, the code tightens the air leakage rate requirements for high-pressure ducts from 6 to 4. In addition, the equation referenced by this section to calculate the rate of air leakage has been rewritten. The provisions for the 2015 code discussed in the descriptions above are as or more stringent than the provisions in the 2012 IECC.
- o Section C403.2.11 describing mechanical system commissioning and completion requirements now point to section C408.2 describing mechanical systems and service water heating systems commissioning and completion requirements, which has been updated in the 2015 code. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section 403.2.12 describing air system design and control has been modified.
 - Section C403.2.12.1 describing allowable fan floor horsepower has been modified in the 2015 code to exclude fans exhausting air from fume hoods from the exceptions that not required to meet the allowable fan floor horsepower. The section refers to Table C403.2.12.1 (1) for fan power definitions and Table C403.2.12.1 (2) for fan power limitations pressure drop adjustment. In Table C403.2.12.1(2) information regarding equipment systems without central heating or cooling device and systems with central

electric heat has been added to get deductions for fan power limitation pressure drop adjustment. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.

- Section C403.2.12.3 describing fan efficiency has been added to the code. The section introduces fan efficiency grade requirements for most fans. Certain fans are excluded from these requirements. The provisions for the 2015 code discussed in these sections are as or more stringent than the provisions in the 2012 IECC.
- Section C403.2.14 describing refrigeration equipment performance has been added in the 2015 code. The section provides performance requirements for commercial refrigeration equipment. The section refers to Table 403.2.14(1) for minimum efficiency requirements for commercial refrigeration and Table 403.2.14(2) for minimum efficiency requirements for commercial refrigerators and freezers. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- Section C403.2.15 describing walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers has been introduced in the 2015 IECC. The section provides several requirements for coolers and freezers that are not site constructed or assembled to comply with the code. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- Section C403.2.16 describing walk-in coolers and walk-in freezers has been introduced in the 2015 code. The section provides requirements for coolers and freezers that are site assembled or site constructed to comply with the code. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- Section C403.2.17 describing refrigerated display cases has been introduced in the 2015 code. The section provides requirements for refrigerated cases that are site assembled or site constructed to comply with the code. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.

Section 403.3 describing economizers has been reorganized by rearranging components from different sections in the 2012 IECC. Economizer requirements have now been relaxed from cooling system capacities $\geq 33,000$ Btu/hr as specified in the 2012 code to $\geq 54,000$ Btu/hr specified in the 2015 code. Certain exceptions have been added which allow passive chilled water cooling systems or systems that include a heat recovery system. In addition, the section now refers to Table C403.3 (1) for minimum chilled water system cooling capacity for determining economizer cooling requirements. At first glance, the change for requirement for economizers from 33,000 Btu/h to 54,000 Btu/h would infer less stringency in the IECC2015 version; however, the added level of detail in the requirements of IECC2015 may actually add to stringency in the larger size systems. Firstly, the Table C403.3(1) in IECC2015 cannot be compared to a corresponding table in IECC 2012. While the IECC 2012 table sets a strict limit based on total system capacity, the IECC2015 table differentiates between water-cooled and air-cooled systems. Also the requirements are based on the “Difference between the total chilled-water system capacity and the capacity of the cooling units” rather than the HVAC system capacity alone. Added to this is a list of around 14 other detailed requirements imposed on the system. Because of the added details, a qualitative analysis cannot be used to determine the stringency of the equation provided in this section. However, is a more clear guidance as to what requirements must be met on all the auxiliary equipment involved in economizer systems. Further modifications to this section are discussed in the paragraphs below:

- Section 403.3.1 describing integrated economizers have been rewritten in the 2015 code to clarify the integration of economizers with mechanical cooling systems. This section now points to Table C403.3.1 for DX cooling stage requirements for modulating air-flow units. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- Section 403.3.2 describing economizer heating system has been re-worded in the 2015 IECC. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.

- Section C403.3.3 describing air economizers has been expanded in the 2015 code to incorporate Section C403.3.3.5 on economizer dampers. According to this sub-section economizer dampers are now required to comply with Section C403.2.4.3 on shutoff dampers, which is more stringent than the 2015 IECC. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- Section 403.3.4 describing water economizers have been updated in the 2015 code. These include provisions for design capacity as provided in Section C403.3.4.1 and maximum pressure drop as described in Section 403.4.2.
 - Section C403.3.4.1 provides requirements of the design capacity of water economizers. Exceptions describing systems that do not require water economizers have been added. The provisions in this section makes the air economizer requirements consistent with ANSI/ASHRAE/IES Standard 90.1-2013. The updated specifications provide exceptions for computer rooms allowing such spaces to avoid water economizers even if the loads cannot be met when the outdoor temperatures are 50 F and less. Such spaces only need the economizer if they cannot meet the AC load at 40 F or even 30 F. The provisions of this section decrease the stringency of the 2015 IECC over the 2012 IECC.

Section C403.4 describing hydronic and multiple-zone HVAC systems controls and equipment has been modified in the 2015 code to show consistency with the corresponding ASHRAE Standard 90.1-2013. The changes and modifications introduced to this section are described in the paragraphs below:

- Section C403.4.1 describing fan control has been elaborated to provide specifications for fan airflow control, static pressure sensor location and setpoints for direct digital control.
 - Section C403.4.1.1 describing fan airflow control now elaborates on the fan controls based on methods implemented by DX and chilled water cooling units and units that include airside economizers to control space temperature. The section now points to Table C403.4.1.1 for appropriate fan motor sizes and mechanical cooling capacity for different system types. The provisions for the 2015 code discussed in the descriptions above are more stringent than the provisions in the 2012 IECC.
 - Section C403.4.1.2 describing static pressure sensor location has been modified in the 2015 code. The code now requires the controller setpoints to be no greater than 1.2 inch w.c. instead of $\frac{1}{3}$ of the total design fan static pressure as required in the 2012 IECC. The provisions for the 2015 code discussed in the descriptions above are as or more stringent than the provisions in the 2012 IECC.
 - The requirements for setpoints for direct digital controls in Section C403.4.1.3 have been elaborated. The direct digital controls are now required to either have capabilities to monitor the position of zone dampers or have an alternate method of indicating the need for static pressure that is capable of automatically detecting any zone that excessively drives the reset logic, generating an alarm to the system operational location and allowing an operator to readily remove one or more zones from the reset algorithms. The provisions for the 2015 code discussed in this section are more stringent than the provisions in the 2012 IECC.
- Section C403.4.2 on hydronic systems controls has been elaborated to describe part-load controls for such system and boiler turndown ratios.
 - In Section C403.4.2.4 describing part-load controls, although the capacity of the hydronic systems eligible to include controls is relaxed from 300,000 Btu/hr to 500,00 Btu/hr. The compliance requirements have been modified that now require capabilities to include resetting supply-water temperature, automatic varying of fluid flow, automatic varying of pump flow on chilled water systems and heat rejection loops. The provisions aim to match the requirement in the IECC with the corresponding requirements provided in the ASHRAE Standard 90.1-2013. The provisions of this section decrease the stringency of the 2015 IECC over the 2012 IECC. It should be noted that the initial capacities represent

- small building sizes, which are generally not served by hydronic systems. Hence providing part load controls to systems serving such capacities would provide small energy benefits relative to the added control costs and benefits.
- Section C403.4.2.5 describing boiler turn down requires boiler systems greater than 1,000,000 Btu/hr to comply with turndown ratios provided in Table C403.4.2.5. The provisions aim to match the requirement in the IECC with the corresponding requirements provided in the ASHRAE Standard 90.1-2013. The provisions for the 2015 code discussed in this section are more stringent than the provisions in the 2012 IECC.
 - o Section C403.4.3 describing heat rejection has been elaborated in the 2015 IECC. The section now introduces requirements for fan speed control, limitations on centrifugal fan open-circuit cooling towers and requirements for tower flow turndown for heat rejection equipment such as air-cooled condensers, dry coolers, open circuit cooling towers, closed -circuit cooling towers and evaporative condensers in the code.
 - Section 403.4.3.2 describing fan speed control elaborates the implementation of fan speed control of heat rejection equipment. In Section C403.4.3.2.1 describing fan motors not less than 7.5 hp, the code provides requirements for fans greater than or equal to 7.5 hp to operate fans at lower speeds in response to leaving fluid temperature or condensing temperature / pressure of the heat rejection device. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC. Section C403.4.3.2.2 describing multiple-cell heat rejection equipment has been added to the 2015 code. The section now provides specifications to control the variable speed fan drives installed in this equipment. The provisions for the 2015 code discussed in this section are more stringent than the provisions in the 2012 IECC.
 - In Section C403.4.3.3 describing limitations on centrifugal fan open-circuit cooling towers, the 2015 code introduces requirements for open-circuit cooling-towers of certain capacity to meet the requirements for axial fan open circuit cooling towers in Table C403.2.3(8). The provisions for the 2015 code discussed in this section are more stringent than the provisions in the 2012 IECC.
 - In Section C403.4.3.4 describing tower flow turndown, the 2015 code introduces requirements for controls for open-circuit cooling-towers. The provisions for the 2015 code discussed in this section are more stringent than the provisions in the 2012 IECC.
 - o Section C403.4.4 describing requirements for complex mechanical systems serving multiple zones was modified in the 2015 code to include two more provisions for reducing primary air supply to each zone. The added provisions include: any higher rate that can be demonstrated to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake for the system as approved by the code official; and the airflow rate required to comply with applicable codes or accreditation standards such as pressure relationships or minimum air changes. The provisions for the 2015 code discussed in this section are more stringent than the provisions in the 2012 IECC.
 - Section 403.4.4.4 describing fractional hp fan motors has been added in the 2015 code. The 2015 code now requires electronically commutated motors or 70% motor efficiency for fans between 1/12 hp and 1hp. The section also allows the use of sheave adjustment instead of varying the motor speed. The provisions aim to match the requirement in the IECC with the corresponding requirements provided in the ASHRAE Standard 90.1-2013. The provisions for the 2015 code discussed in this section are more stringent than the provisions in the 2012 IECC.
 - o Section 403.4.6 describing hot gas bypass limitations has been modified in the 2015 code. The 2015 code now sets limitations to the use of hot gas bypass in terms of control and capacity. Limitations to the hot gas bypass is now provided in Table C403.4.6. The provisions for the 2015 code discussed in this section are more stringent than the provisions in the 2012 IECC.

Section C403.5 describing refrigeration systems has been introduced in the 2015 IECC. The section provides specifications for refrigeration equipment that is served by remote compressors and condensers. Modifications to this section are discussed in the paragraphs below:

- In Section C403.5.1 describing condensers serving refrigeration systems, remote condensers serving the refrigerated display cases now have to comply with the specifications for saturated condensing temperatures, condenser fan power ratings, variable speed fan control, and condensing temperature setpoint. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.
- In Section C403.5.2 describing compressors systems, remote compressors serving the refrigerated display cases now have to comply with requirements suction group controls, subcooling and crankcase heater control. The provisions of this section increase the stringency of the 2015 IECC over the 2012 IECC.

2.4 Comparing the Provisions in Section C404 ‘Service Water Heating’

Section C404.2 describing the service water heating equipment performance efficiency has been modified in the 2015 code to include water-heating equipment intended for space heating. The section refers to Table C404.2 for minimum performance of water heating equipment. The table has been updated to provide more stringent requirements for electric water heaters > 12 kW, oil storage water heaters > 105,000 Btu/h, and pool water heaters. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.

Section C404.4 on pipe insulation has been expanded to clarify insulation requirements for non-circulating systems. The section refers to Table C403.2.10 for minimum pipe insulation thickness for different fluid temperatures and nominal pipe sizes. The section also lists certain exceptions which do not require tubular pipe insulation. The provisions in this sections increase the stringency of the 2015 IECC over the 2012 IECC.

Section C404.5 on efficient heated water supply piping was added in the 2015 code. This section remedies the problems of delivery of hot water to the point of use by reducing the water volume between the source of heated water and the use. The section provides maximum flow rates for different nominal pipe sizes. The section also requires heated water supply pipes to comply with Section C404.5.1 for maximum allowable pipe length method or Section C404.5.2 for maximum allowable pipe volume method. The first method (Section C404.5.1) requires no calculation; it limits the water volume in the pipes by limiting the pipe length. The second option (Section C404.5.2) requires a calculation of volume in the pipes, but provides a table that translates the pipe length into a volume and provides quick options for different pipe assumptions as provided in Section C404.5.2.1 on water volume determination. Table C404.5.1 has been introduced in the 2015 code to provide maximum piping volume and maximum piping lengths for different nominal pipe sizes. The provisions in this sections increase the stringency of the 2015 IECC over the 2012 IECC.

Section C404.6 on heated water circulating and temperature maintenance system has been elaborated in the 2015 IECC to include specifications for circulation systems in Section C404.6.1, heat trace systems in Section C404.6.2 and controls for hot water storage in Section C404.6.3. The provisions in this sections increase the stringency of the 2015 IECC over the 2012 IECC.

Specifications for demand recirculation controls in Section 404.7 and drain water heat recovery units in Section C404.8 have been introduced in the 2015 code. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.

Section C404.9 on energy consumption of pools and permanent spas has been re-worded in the 2015 code. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC. The modifications to the section are presented in the paragraphs below:

- In Section 404.9.1 on heaters, the 2015 code provides clarification for requirements of the On-Off switches for heaters.
- In Section C404.9.2 on time switches, the 2015 code is rewritten to provide clarification for the requirement of time switches.
- In Section C404.9.3 on covers the 2015 code is rewritten to provide clarification for the requirement of vapor-retardant covers.

Section C404.10 on energy consumption of portable spas has been introduced in the 2015 code to clarify compliance requirements for electric-powered portable spas. The provisions in this sections increase the stringency of the 2015 IECC over the 2012 IECC.

Section C404.11 on service water heating system commissioning and completion requirements now requires installed service water systems to be commissioned. The section refers to Section C408.2 for detailed requirements. The provisions in this sections increase the stringency of the 2015 IECC over the 2012 IECC.

2.5 Comparing the Provisions in Section C405 'Electric Power and Lighting Systems'

Section C405.1 describing general provisions for electric power and lighting systems now requires lighting for dwelling units has to comply with appropriate sections in the residential provisions of the code. In addition, provisions for refrigerated spaces are outlined in this section of the code. The provision in this section increases the stringency of the 2015 IECC over the 2012 IECC.

Section C405.2 on lighting controls has been rearranged from the 2012 edition of the code. This section has been modified to include a separate discussion on occupant sensor control and provide an elaborate description of daylighting controls. The modified sections are presented in the following paragraphs:

- Section C405.2.1 on occupant sensor controls now makes it mandatory to install occupancy sensors for certain types of spaces. The provision in this section increases the stringency of the 2015 IECC over the 2012 IECC.
 - Section C404.2.1.1 on occupant sensor control function and Section C404.2.1.2 on occupant sensor control function in warehouses provide specifications for lighting controls for the spaces. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.
- Section 405.2.2 on time switch controls has been reorganized to describe options for time switch controls in spaces where occupancy sensors are not required. The addition of shop and laboratory spaces to exceptions that do not require time switches makes the provisions of this section less stringent than those in the 2012 IECC.
 - Section 405.2.2.1 on time switch control function has been rewritten in the 2015 code to combine provisions for occupant override and holiday scheduling into one section. New provisions have been added that now require override switches to have 7 day clocks and have program backup capabilities. The provision in this section increases the stringency of the 2015 IECC over the 2012 IECC.
 - Section 405.2.2.2 on light reduction controls has been rearranged in the 2015 code. Section C405.2.2.3 on manual controls has been rearranged from the 2012 code. The provisions in these sections do not impact the stringency of the 2015 IECC over the 2012 IECC.
- In Section C405.2.3 on daylight responsive controls, the 2015 code now provides detailed requirements for the installation of daylight-responsive controls. The section describes the space conditions in which daylighting controls are to be installed. While the maximum size of zone

(i.e. 2500 sqft) to be provided by daylight controls has been removed in the 2015 code, the level of detail on daylight controls that are described in a variety of space types and shapes far exceeds the specifications in the 2012 IECC. It's likely that the individual daylighting controls could be required in spaces far below 2500 sqft. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.

- Section C405.2.3.1 on daylight responsive control function elaborates on the strategies that are to be implemented for daylight controls. The requirements in this section to dim lights continuously from a full light output to 15 percent of full light output or lower in office spaces, laboratories and classrooms increase the stringency of the 2015 IECC over the 2012 IECC.
- Section C405.2.3.2 on sidelight daylighting zone provides detailed definition of a sidelight daylight zone with appropriate diagrams provided in Figure 405.2.3.2(1), Figure 405.2.3.2(2) and Figure 405.2.3.2(3). Section C405.2.3.3 on toplight daylight zone provides a detailed description and definition of a toplight daylight zone with appropriate diagrams provided in Figure C405.2.3.3. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section C405.2.4 on specific applications controls provides specifications for applications such as display and accent lighting, display case lighting and lighting for hotel and motel sleeping units. This section has added requirements for hotel and motel sleeping units. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.
- o Section C405.2.5 on exterior lighting controls provides elaborate description of the control strategies for lighting of exterior applications. The section has been reorganized to describe controls for various types of exterior lighting. In addition, the section now requires the ability to reduce exterior lighting levels for designated periods of time for certain types of lighting, which implies the appropriate use of either time switches or motion sensors. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.

Section 405.4 describes interior lighting power requirements in the 2015 code. Changes in this section are documented in the paragraphs below:

- o Section 405.4.1 on total connected interior lighting power now describes an equation to calculate the total interior lighting power that has been reorganized from the 2012 IECC. Changes have also been made to the exceptions for lighting equipment that are not to be included in calculating total connected lighting power. The exception for sleeping units now requires lighting in the units to comply with corresponding residential provisions in the 2015 code. In addition, mirror lighting in dressing rooms and lighting for exit signs are now included as part of the exceptions. The provisions in these sections do not impact the stringency of the 2015 IECC over the 2012 IECC.
- o Section C405.4.2 describes the permissible allowances for interior lighting power that are required for compliance. Changes to this section are documented in paragraphs below:
 - Section C405.4.2.1 describing the 'building area method' for compliance refers to Table C405.4.2 (1), which has been updated with lower permissible lighting power. The provisions in this section increase the stringency of the 2015 IECC over the 2009 IECC.
 - Section 405.4.2.2 describing the space-by-space method for compliance has been introduced to add flexibility for a more accurate assessment of lighting provisions for compliance. The section points to Table C405.4.2 (2) which describes interior lighting power allowances for space-by-space methods. This table has been updated with lower permissible lighting power. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC. When using space-by-space method for compliance additional interior lighting power requirements are now provided in Section C405.4.2.2.1. The provisions in these sections do not impact the stringency of the 2015 IECC over the 2012 IECC.

Section 405.5 describes provisions for exterior lighting in the 2015 code. Changes in this section are described in the paragraphs below:

- Section C405.5.1 for exterior building lighting power refers to Table C405.5.2(1) for definition of exterior lighting zones and Table C405.5.2(2) for individual lighting power allowances for building exterior. Table C405.5.2(1) has been reworded in the 2015 code. The provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC. Table C405.5.2(2) is largely unchanged except in the section on non-tradable surfaces. In this section, lower power densities are now required for building facades in the 2015 code. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.

Section C405.6 on electric energy consumption has been reorganized in the 2015 code. The provisions in these sections do not impact the stringency of the 2015 IECC over the 2012 IECC.

Several sections have been added to the 2015 IECC to match the provisions in the code with the provisions in the ASHRAE Standard 90.1-2013 to ensure a consistency between the two standards. These include: Section 405.7 for electrical transformers and Table C405.7 for minimum nominal efficiency levels for 10 CFR 431 low-voltage dry-type distribution transformers; Section 405.8 on electrical motors and Table C405.8(1), Table C405.8(2), Table C405.8(3) and Table C405.8(4) describing efficiencies for different types of electrical motors; Section C405.9 on vertical and horizontal transportation systems and equipment, which includes information in Section C405.9.1 for elevator cabs and Section C405.9.2 for escalators and moving walks. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.

2.6 Comparing the Provisions in Section C406 ‘Additional Efficiency Package Options’

This section has been elaborated in the 2015 IECC to facilitate compliance using prescriptive path. When showing compliance using the prescriptive path, the user is now required to meet the requirements of any one of the subsections in this section in addition to other prescriptive and mandatory requirements. Requirements of this section have been subdivided into the following categories: more efficient HVAC equipment performance; reduced lighting power density; enhanced digital lighting controls; on-site renewable energy; dedicated outdoor air system; and reduced energy use in service water system. The provisions for improved lighting, service water heating and dedicated outdoor air system have been added in the 2015 code. Although this section provides more flexibility to comply with the 2015 code, the provisions in this section are more stringent than the corresponding provisions in the 2012 IECC. A brief description of the sub-sections that have been added is provided in the paragraphs below:

- Section C406.2 describing more efficient HVAC equipment performance requires equipment complying using the prescriptive path to exceed the minimum efficiencies listed in section on building mechanical equipment in the 2015 code by 10 percent.
- Section C406.3 describing reduced lighting power density requires the total lighting power in a building complying with the prescriptive path of the 2015 code to be determined using 90 percent of the lighting power values specified in the section on lighting systems in the 2015 code.
- Section C406.4 describing the requirement of enhanced digital lighting controls, requires interior lighting to be scheduled and operated in accordance with the section on lighting controls (Section C405.2.2) of the code. This non-lighting power density lighting alternative package requires a digital control system to allow continuous dimming and a significant level of controllability on individual luminaires, or groups of no more than eight luminaires.
- Section C406.5 provides the minimum ratings for renewable energy generated on-site. Section C406.6 requires buildings with hydronic and multi-zone HVAC systems controls and equipment to be equipped with independent systems that provide 100 percent outdoor air to each occupied space.

- Section C406.7 describing reduced energy use in service water systems requires service water heaters in certain types of buildings to install water heat recovery or solar water heating methods.

2.7 Comparing the Provisions in Section C407 'Total Building Performance'

Section C407 for 'Total Building Performance' has been updated in the 2015 IECC. Not many changes have been made in this section of the 2015 code when compared to the 2012 code. However, since this section of the code references other sections that are more stringent, it can be concluded that compliance with this section of the 2015 IECC is more stringent than the corresponding section of the 2012 IECC.

Several modifications were made to this section of the 2015 code. The provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC. The changes are listed in the paragraphs below:

- Table C407.5.1(1) describing specifications for Standard Reference and Proposed Design requires service water heating efficiency to be calculated by multiplying the given efficiency with either the either SWHF (Service water heat recovery factor) or DHWR (Drain water heat recovery). This provision is made to enable developers to take credit for efficiency improvements due to the use of hot water recovery systems. In addition, the table points to several other tables elsewhere in the code which are more stringent than the corresponding specifications in the 2012 IECC.
- Table C407.5.1(3) describing the specifications for the Standard Reference Design HVAC systems modifies footnote d, which describes the provisions for VAV fans. The footnote has been modified to remove the language allowing constant volume systems to be modeled as an exception.
- Section C407.6 describing the calculation software tools is modified to remove the item describing the removal of item 1 which requires the generation of standard reference design using input from proposed design. The removal of this item addresses the issue that no existing software tools are capable of meeting the requirements described in this section. If the language remains as written, the Total Building Performance path cannot be used. This correction maintains a complete performance path for compliance with the Code, which promotes innovation and flexibility in design and construction.
- Section C407.6.3 describing exceptional calculation methods has been added in the code to provide guidance to designers, modelers and building officials for implementing efficiency measures that cannot be directly modeled by the hourly analysis software used for compliance.

2.8 Comparing the Provisions in Section C408 'System Commissioning'

Section C408 for 'System Commissioning' has been updated in the 2015 IECC. The additions in this section of the code are described in the paragraphs below:

- Section 408.2 and the corresponding sub-sections describing the mechanical systems and service water heating systems commissioning has been reworded in the 2015 IECC to provide further clarifications to the requirements introduced. The updated provisions in this section do not impact the stringency of the 2015 IECC over the 2012 IECC.
- Section 408.3 describing the lighting system functional testing has been modified. Section C408.3.1 on functional testing has been expanded to include Section C408.3.1.1 on occupant sensor control, Section C408.3.1.2 on Time-switch controls, Section C408.3.1.3 on daylight responsive controls and Section C408.3.2 on documentation. The updated provisions in these sections increase the stringency of the 2015 IECC over the 2012 IECC.

3. CONCLUSIONS

This analysis compares the commercial provisions in the 2012 IECC, and the 2015 IECC. The analysis was performed in terms of a qualitative assessment comparing all the sections in Chapter 4[CE] of the 2012 IECC and Chapter 4 [CE] of the 2015 IECC.

When comparing the requirements in Section C401 of the 2015 IECC with Section C401 of the 2012 IECC for ‘General’ requirements, it was concluded:

- To demonstrate compliance with the first path provided in the code, it was now required to comply with the provisions in the ASHRAE Standard 90.1-2013.
- Compliance for existing buildings is now provided in Chapter 5[CE] of the 2015 IECC.

When comparing the requirements in Section C402 of the 2015 IECC with Section C402 of the 2012 IECC for ‘Building Envelope Requirements’, the 2015 code demonstrated:

- Improved specifications for opaque building components.
- Improved specifications for fenestration.
- Expanded requirements to calculate U-factors of walls with cold-formed steel, aged roof reflectance and provisions for rooms containing fuel burning appliances.

When comparing the requirements in Section C403 of the 2015 IECC with Section C403 of the 2012 IECC for ‘Building Mechanical Systems’, the 2015 code demonstrated:

- Improved efficiency requirements for HVAC equipment performance.
- Added efficiency requirements for air-conditioning units serving computer rooms.
- Added specifications for commercial refrigeration equipment.
- Elaborated and added provisions for HVAC system controls which include: requirement for zone isolation; and requirement of economizer fault detection.
- Added specifications for hot water boiler outdoor temperature setback control.
- Updated provisions for energy recovery ventilation systems whose requirements are now based on the number of hour’s ventilations systems operate.
- Introduced specifications for kitchen exhaust systems.
- Updated requirements for duct and plenum insulation and sealing.
- Introduced fan efficiency requirements.
- Updated provisions for air and water economizers, which include added requirements for the efficient operation of these systems.
- Updated provisions for complex mechanical systems serving multiple zones, which include updated specifications for fan controls, heat rejection equipment and hot gas bypass limitations.

When comparing the requirements in Section C404 of the 2015 IECC with Section C404 of the 2012 IECC for ‘Service Water Heating’, the 2015 code demonstrated:

- Improved specifications for certain categories of service hot water systems.
- Improved specification for insulation of piping.
- Improved specifications for energy consumption of pools and permanent spas.
- Added information for implementation of efficient heated water supply piping, heated water circulating and temperature maintenance system, demand recirculation controls, drain water heat recovery systems and energy requirements of portable spas.
- Added commissioning requirements for hot water systems.

When comparing the requirements in Section C405 of the 2015 IECC with Section C405 of the 2012 IECC for ‘Electric Power and Lighting Systems’, the 2015 code demonstrated:

- Elaborate provisions for lighting controls, which include the added requirement of occupant sensor controls.

- Elaborate provisions for daylight responsive controls.
- Improved specifications for permissible lighting power densities for different building area types.
- Improved specifications for non-tradable components of exterior lighting.
- Added requirements for electric transformers, electric motors as well as vertical and horizontal transportation system and equipment.

Section C406 for ‘Additional Efficiency Package Options’ has been updated in the 2015 IECC. Requirements of this section have been subdivided into the following categories: more efficient HVAC equipment performance; reduced lighting power density; enhanced digital lighting controls; on-site renewable energy; dedicated outdoor air system; and reduced energy use in service water system.

Section C407 for ‘Total Building Performance’ has been updated in the 2015 IECC. Not many changes have been made in this section of the 2015 code. However, since this sections of the code references other sections which are more stringent, it can be concluded that compliance with this section is more stringent.

Section C408 for ‘System Commissioning’ has been updated in the 2015 IECC. New requirements have been added for lighting system functional testing, which include: occupant sensor controls, time control switches, daylight responsive controls and documentation requirements for lighting controls in construction documents.

It should be noted that several provisions in the 2015 IECC could not be assessed qualitatively. A quantitative assessment is necessary to determine the stringency of these provisions. These provisions include:

- Introducing the component performance alternative in Section 402.1.5.
- Increasing the maximum permissible area limits for skylights with the addition of daylight responsive controls in Section C402.4.1.1 and Section C402.4.1.2 respectively.
- Increasing specifications for SHGC and U-value for skylights for zones provided with daylight responsive controls in Section C402.4.2.
- Provisions for guidelines to calculate the adjustment factor for water cooled chillers in the case of chilled water temperature being different as described in Section C403.2.3.1.

It is concluded that the provisions for commercial buildings in the 2015 IECC are more stringent than the corresponding provisions in the 2012 IECC.



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APPENDIX A

Assessment of stringency for the commercial provisions in the 2015 IECC when compared to corresponding provisions in the 2012 IECC

Note for color coding:

	Sections modified from 2012 IECC
	Sections added to the 2015 IECC

2015 IECC Section No.		Stringency vs. 2012 IECC
C401 General	C401.1 Scope	More Stringent
	C401.2 Application	More Stringent
	C401.2.1 Application to replacement fenestration products	More Stringent
C402 Building Envelope Requirements	C402.1 General	More Stringent
	C402.1.1 Low-energy buildings	As Stringent
	C402.1.2 Equipment buildings	As Stringent
	C402.1.3 Insulation component R-value based method	More Stringent
	Table C402.1.3 Opaque Thermal Envelope Component Minimum Requirements, R-value Method	More Stringent
	C402.1.4 Assembly U-factor, C-factor or F-factor-based method	More Stringent
	Table C402.1.4 Opaque Thermal Envelope Component Minimum Requirements, U-factor Method	More Stringent
	C402.1.4.1 Thermal resistance of cold-formed steel walls	More Stringent
	Table C402.1.4.1 Effective R-value for Steel Stud Wall Assemblies	More Stringent
	C402.1.5 Component performance alternative	Cannot Determine
	C402.2 Specific building thermal envelope insulation requirements	More Stringent
	C402.2.1 Multiple layers of continuous insulation	More Stringent
	C402.2.2 Roof assembly	More Stringent
C402.2.3 Thermal resistance of above-grade walls	More Stringent	

2015 IECC Section No.			Stringency vs. 2012 IECC	
C402 Building Envelope Requirements	C402.2	C402.2.4 Floors	Less Stringent	
		C402.2.5 Slab-on-grade perimeter insulation	As Stringent	
		C402.2.6 Insulation of radiant heating systems	More Stringent	
	C402.3 Roof solar reflectance and thermal emittance		As Stringent	
		Table C402.3 Minimum Roof Reflectance and Emittance Options	As Stringent	
	C402.3.1 Aged roof solar reflectance		More Stringent	
	C402.4 Fenestration		More Stringent	
	C402.4 Fenestration		Table C402.4 Building Envelope Requirements: Fenestration	More Stringent
	C402.4.1 Maximum area		As Stringent	
		C402.4.1.1 Increased vertical fenestration area with daylight responsive controls	Less Stringent	
		C402.4.1.2 Increased skylight area with daylight responsive controls	As Stringent	
	C402.4.2 Minimum skylight fenestration area		More Stringent	
		C402.4.2.1 Lighting controls in daylight zones under skylights	More Stringent	
		C402.4.2.2 Haze factor	As Stringent	
	C402.4.3 Maximum U-factor and SHGC		More Stringent	
		C402.4.3.1 Increased skylight SHGC	As Stringent	
		C402.4.3.2 Increased skylight U-factor	As Stringent	
	C402.4.3.3 Dynamic glazing	More Stringent		
	C402.4.3.4 Area-weighted U-factor	As Stringent		

2015 IECC Section No.			Stringency vs. 2012 IECC
C402 Building Envelope Requirements	C402.4	C402.4.4 Doors	As Stringent
	C402.5	Air leakage	More Stringent
		C402.5.1 Air barriers	More Stringent
		C402.5.1.1 Air barrier construction	As Stringent
		C402.5.1.2 Air barrier compliance options	-
		C402.5.1.2.1 Materials	Less Stringent
		C402.5.1.2.2 Assemblies	Less Stringent
		C402.5.2 Air leakage of fenestration	More Stringent
		Table C402.5.2 Maximum Air Leakage Rate for Fenestration	More Stringent
		C402.5.3 Rooms containing fuel burning appliances	As Stringent
		C402.5.4 Doors and access openings to shafts, chutes, stairways and elevator lobbies	As Stringent
		C402.5.5 Air intakes, exhaust openings, stairways and shafts	As Stringent
	C402.5.7 Vestibules	More Stringent	
	C402.5.8 Recessed lighting	As Stringent	
C403 Building Mechanical Systems	C403.1	General	More Stringent
	C403.2 Provisions applicable to all mechanical systems	C403.2.1 Calculation of heating and cooling loads	As Stringent
		C403.2.2 Equipment sizing	As Stringent
		C403.2.3 HVAC equipment performance requirements	More Stringent
		Table 403.2.3 (1) - (8), (10)	More Stringent

2015 IECC Section No.				Stringency vs. 2012 IECC	
C403 Building Mechanical Systems	C403.2 Provisions applicable to all mechanical systems	C403.2.3	Table 403.2.3(9) Minimum Efficiency Air Conditioners and	More Stringent	
			C403.2.3.1 Water cooled centrifugal chilling packages	Cannot Determine	
			C403.2.3.2 Positive displacement chilling packages		More Stringent
		C403.2.4 HVAC system controls	C403.2.4.1 Thermostatic controls	C403.2.4.1.2 Deadband	As Stringent
				C403.2.4.1.3 Setpoint overlap restriction	More Stringent
			C403.2.4.3 Shutoff dampers	More Stringent	
			C403.2.4.4 Zone isolation	More Stringent	
			C403.2.4.5 Snow- and ice-melt system controls	As Stringent	
			C403.2.4.6 Freeze protection system controls	More Stringent	
			C403.2.4.7 Economizer fault detecton and diagnostics (FDD)	More Stringent	
			C403.2.5 Hot water boiler outdoor temperature setback control	More Stringent	
		C403.2.6 Ventilation	C403.2.6.2 Enclosed parking garage ventilation controls	More Stringent	
		C403.2.7 Energy recovery ventilation systems		More Stringent	
		C403.2.7 Energy recovery ventilation systems	Table C403.2.7(1) Energy Recovery Requirements (Ventilation systems operating less than 8,000 hours per year)	More Stringent	
			Table C403.2.7(2) Energy Recovery Requirements (Ventilation systems operating not less than 8,000 hours/year)	More Stringent	
		C403.2.8 Kitchen exhaust systems		More Stringent	
			Table C403.2.8 Maximum Net Exhaust Flow Rate, CFM Per Linear Foot of Hood Length	More Stringent	

2015 IECC Section No.			Stringency vs. 2012 IECC	
C403 Building Mechanical Systems	C403.2 Provisions applicable to all mechanical systems	C403.2.9 Duct and plenum insulation and sealing	More Stringent	
		C403.2.9.1	C403.2.9.1.1 Low-pressure duct systems	As Stringent
			C403.2.9.1.2 High-pressure duct systems	More Stringent
		C403.2.11 Mechanical system commissioning and completion requirements	More Stringent	
		C403.2.12 Air system	C403.2.12.1 Allowable fan floor horsepower	As Stringent
			Table C403.2.10.1(2) Fan Power Limitation Pressure Drop Adjustment	More Stringent
			C403.2.12.3 Fan efficiency	More Stringent
		C403.2.14 Refrigeration equipment performance	More Stringent	
			Table 403.2.14(1) Minimum Efficiency Requirements: Commercial Refrigeration	More Stringent
			Table 403.2.14(2) Minimum Efficiency Requirements: Commercial Refrigerators and Freezers	More Stringent
		C403.2.15 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers	More Stringent	
		C403.2.16 Walk-in coolers and walk-in freezers	More Stringent	
		C403.2.17 Refrigerated display cases	More Stringent	
		C403.3 Economizers	Cannot Determine	
			Table C403.3(1) Minimum Chilled-water System Cooling Capacity for Determining Economizer Cooling Requirements	Cannot Determine
		C403.3.1 Integrated economizers	More Stringent	
C403.3.2 Economizer heating system impact	As Stringent			

2015 IECC Section No.			Stringency vs. 2012 IECC	
C403 Building Mechanical Systems	C403.3 Economizers	C403.3.3 Air economizers	As Stringent	
		C403.3.3.3 High limit shutoff	Table C403.3.3.3 High-limit Shutoff Control Setting for Air Economizers	As Stringent
		C403.3.3.5 Economizer dampers		More Stringent
		C403.3.4 Water economizers		-
		C403.3.4 Water economizers	C403.3.4.1 Design capacity	Less Stringent
			C403.3.4.2 Maximum pressure drop	As Stringent
		C403.4 Hydronic and multiple-zone HVAC systems controls and equipment		-
			C403.4.1 Fan control	More Stringent
			C403.4.1.1 Fan airflow control	More Stringent
		C403.4.1.2 Static pressure sensor location	More Stringent	
		C403.4.1.3 Setpoints for direct digital control	More Stringent	
		C403.4.2 Hydronic system controls	C403.4.2.4 Part-load controls	Less Stringent
			C403.4.2.4 Boiler turndown	More Stringent
			Table C403.4.2.5 Boiler Turndown	More Stringent
		C403.4.3 Heat rejection	C403.4.3.1 General	As Stringent
		C403.4.3.2 Fan speed control	As Stringent	
		C403.4.3.2.1 Fan motors not less than 7.5 hp	As Stringent	
		C403.4.3.2.2 Multiple-cell heat rejection equipment	More Stringent	

2015 IECC Section No.			Stringency vs. 2012 IECC
C403 Building Mechanical Systems	C403.4	C403.4.3.3 Limitations on centrifugal fan open-circuit cooling towers	More Stringent
		C403.4.3.4 Tower flow turndown	More Stringent
		C403.4.4 Requirements for complex mechanical systems serving multiple zones	More Stringent
		C403.4.4.3 Fractional hp fan motors	More Stringent
	C403.4.6 Hot gas bypass limitation	More Stringent	
	C403.5 Refrigeration systems		More Stringent
	C403.5.1 Condensers serving refrigeration systems	More Stringent	
	C403.5.2 Compressor systems	More Stringent	
C404 Service Water Heating	C404.2 Service water heating equipment performance efficiency		More Stringent
		Table C404.2 Minimum Performance of Water Heating Equipment	More Stringent
	C404.2.1 High input-rated service water heating systems		More Stringent
	C404.4 Insulation of piping		More Stringent
	C404.5 Efficient heated water supply piping		More Stringent
	C404.5.1 Maximum allowable pipe length method		More Stringent
		Table C404.5.1 Piping Volume and Maximum Piping Lengths	More Stringent
	C404.5.2 Maximum allowable pipe volume method		More Stringent
		C404.5.2 Water volume determination	More Stringent
	C404.6 Heated-water circulating and temperature maintenance system		More Stringent
		C404.6.1 Circulation systems	More Stringent

2015 IECC Section No.			Stringency vs. 2012 IECC
C404 Service Water	C404.6	C404.6.2 Heat trace systems	More Stringent
		C404.6.3 Controls for hot water storage	More Stringent
	C404.7 Demand recirculation controls	More Stringent	
	C404.8 Drain water heat recovery units	More Stringent	
	C404.9 Energy consumption of pools and permanent spas	As Stringent	
	C404.9.1 Heaters	As Stringent	
		C404.9.2 Time switches	As Stringent
		C404.9.3 Covers	As Stringent
	C404.10 Energy consumption of portable spas	More Stringent	
	C404.11 Service water-heating system commissioning and completion requirements	More Stringent	
	C405 Electrical Power and Lighting Systems	C405.1 General	More Stringent
C405.2 Lighting controls		More Stringent	
C405.2.1 Occupant sensor controls		C405.2.1.1 Occupant sensor control function	As Stringent
		C405.2.1.2 Occupant sensor control function in warehouses	More Stringent
C405.2.2 Time switch controls		Less Stringent	
C405.2.2.1 Time-switch control function		More Stringent	
		C405.2.2.2 Light reduction controls	As Stringent
		C405.2.2.3 Manual controls	As Stringent

2015 IECC Section No.				Stringency vs. 2012 IECC	
C405 Electrical Power and Lighting Systems	C405.2 Lighting controls	C405.2.3 Daylight-responsive controls		More Stringent	
		C405.2.3 Daylight-responsive controls	C405.2.3.1 Daylight-responsive control function		More Stringent
			C405.2.3.2 Sidelight daylight zone		More Stringent
				Figure 405.2.3.2(1) Daylight Zone Adjacent to Fenestration in a Wall	More Stringent
				Figure 405.2.3.2(2) Daylight Zone under Rooftop Monitor	More Stringent
				Figure 405.2.3.2(3) Daylight Zone under Sloped Rooftop Monitor	More Stringent
		C405.2.3.3 Toplight daylight zone			More Stringent
				Figure 405.2.3.3 Daylight Zone under a Roof Fenestration Assembly	More Stringent
		C405.2.4 Specific applications controls			More Stringent
	C405.2.5 Exterior lighting controls			More Stringent	
	C405.4 Interior lighting	C405.4.1 Total connected interior lighting power		As Stringent	
		C405.4.2 Interior lighting power	C405.4.2.1 Building Area Method	Table C405.4.2(1) Interior Lighting Power Allowances: Building Area Method	More Stringent
			C405.4.2.2 Space-by-Space Method	C405.4.2.2.1 Additional interior lighting power	As Stringent
				Table C405.4.2(2) Interior Lighting Power Allowances: Space-by-Space Method	More Stringent
C405.5 Exterior lighting	C405.5.1 Exterior building lighting power		Table C405.5.2(1) Exterior Lighting Zone	As Stringent	
			Table C405.5.2(2) Individual Lighting Power Allowances for Building Exteriors	More Stringent	
C405.6 Electrical energy consumption			As Stringent		

2015 IECC Section No.		Stringency vs. 2012 IECC	
C405 Electrical Power and Lighting Systems	C405.7 Electrical transformers	More Stringent	
		Table C405.7 Minimum Nominal Efficiency Levels for 10 CFR 431 Low-Voltage Dry-type Distribution Transformers	More Stringent
	C405.8 Electrical motors	More Stringent	
		Table C405.8(1) Minimum Nominal Full-Load Efficiency for 60 HZ NEMA General Purpose Electric Motors (Subtype 1) Rated 600 Volts or Less	More Stringent
		Table C405.8(2) Minimum Nominal Full-Load Efficiency of General Purpose Electric Motors (Subtype II) and All Design B Motors Greater than 200 HP	More Stringent
		Table C405.8(3) Minimum Average Full Load Efficiency PolyPhase Small Electric Motors	More Stringent
		Table C405.8(4) Minimum Average Full Load Efficiency For Capacitor-Start Capacitor-Run and Capacitor-Start Induction-Run Small Electric Motors	More Stringent
	C405.9 Vertical and horizontal transportation systems and equipment	More Stringent	
	C405.9.1 Elevator cabs	More Stringent	
	C405.9.2 Escalators and moving walks	More Stringent	
	C405.9.2.1 Regenerative drive	More Stringent	
C406 Additional Efficiency Package Options		More Stringent	
C406.1 Requirements	More Stringent		
	C406.1.1 Tenant spaces	More Stringent	
C406.2 More efficient HVAC equipment performance	More Stringent		

2015 IECC Section No.				Stringency vs. 2012 IECC
C406 Additional Efficiency Package Options	C406.3 Reduced lighting power density			More Stringent
	C406.4 Enhanced digital lighting controls			More Stringent
	C406.5 On-site renewable energy			More Stringent
	C406.6 Dedicated outdoor air system			More Stringent
	C406.7 Reduced energy use in service water heating			More Stringent
		C406.7.1	Load fraction	
C407 Total Building Performance	C407.5	C407.5.1	Table C407.5.1(1) Specifications for the Standard Reference and Proposed Designs	More Stringent
			Table C407.5.1(3) Specifications for the Standard Reference Design HVAC System Description	More Stringent
	C407.6 Calculation software tools			As Stringent
		C407.6.3	Exceptional calculation methods	
C408 System Commissioning	C408.1 General			As Stringent
	C408.2 Mechanical systems and service water heating systems commissioning and completion requirements			As Stringent
		C408.2.1 Commissioning path		As Stringent
		C408.2.2	C408.2.2.1 Air systems balancing	As Stringent
		C408.2.2	C408.2.2.2 Hydronic systems balancing	As Stringent
		C408.2.3	C408.2.3.2 Controls	As Stringent
		C408.2.4 Preliminary commissioning report		As Stringent

2015 IECC Section No.			Stringency vs. 2012 IECC
C408	C408.2	C408.2.4.1 Acceptance of the report	As Stringent
		C408.2.5 Documentation requirements	As Stringent
		C408.2.5.2 Manuals	As Stringent
		C408.2.5.4 Final commissioning report	As Stringent
	C408.3 Lighting systems functional test	C408.3.1 Functional testing	As Stringent
		C408.3.1.1 Occupant sensor control	More Stringent
		C408.3.1.2 Time-switch control	More Stringent
		C408.3.1.3 Daylight responsive control	More Stringent
		C408.3.2 Documentation requirements	More Stringent

APPENDIX B

Assessment of stringency for the commercial provisions in the 2015 IECC when compared to corresponding provisions in the 2009 IECC

The analysis performed in this section compares the commercial provisions in the 2009 IECC, and the 2015 IECC. A qualitative analysis was performed comparing all the sections in Chapter 5 of the 2009 IECC and Chapter 4 [CE] of the 2015 IECC. The analysis categorizes the impact of these changes in terms of stringency over the 2009 code. No attempt has been made to provide a quantitative assessment using whole-building simulation. Hence, certain provisions in the 2015 code could not be assessed and have been identified as such.

When comparing the requirements in Section C401 of the 2015 IECC with Section 501 of the 2009 IECC for ‘General’ requirements, it was concluded:

- To demonstrate compliance with the first path provided in the code, it was now required to comply with the provisions in the ASHRAE Standard 90.1-2013.
- To demonstrate compliance with the prescriptive path provided in the code, in addition to the prescriptive requirements, it is now required to demonstrate compliance with the section on additional efficiency package options (Section C406).
- To demonstrate compliance with the performance path provided in the code, in addition to the performance path requirements, it was now required to demonstrate an energy cost that is less than or equal to 85 percent of the standard reference design building.

When comparing the requirements in Section C402 of the 2015 IECC with Section 502 of the 2009 IECC for ‘Building Envelope Requirements’, the 2015 code demonstrated:

- Improved specifications for opaque building components.
- Improved specifications for fenestration.
- Incorporation of daylighting strategies and controls in provisions for fenestration and skylights.
- Expanded requirements to comply with the provisions for air leakage.

When comparing the requirements in Section C403 of the 2015 IECC with Section 503 of the 2009 IECC for ‘Building Mechanical Systems’, the 2015 code demonstrated:

- Improved efficiency requirements for HVAC equipment performance.
- Added efficiency requirements for heat rejection equipment, heat transfer equipment, air-conditioning units serving computer rooms, and commercial refrigeration equipment.
- Added specifications for commercial refrigeration equipment.
- Elaborated and added provisions for HVAC system controls which include: thermostatic controls; off-hour controls; shutoff dampers; requirement for zone isolation; and requirement of economizer fault detection.
- Added specifications for hot water boiler outdoor temperature setback, kitchen exhaust systems and commercial refrigeration systems.
- Updated provisions for ventilation requirements with reduced occupancy requirements for provision of demand control ventilation.
- Updated provisions for energy recovery ventilation systems with reduced outdoor air requirements for the provision of such systems.
- Updated provisions for air and water economizers, which include added requirements for the efficient operation of these systems.
- Updated provisions for complex mechanical systems serving multiple zones, which include updated specifications for fan controls, hydronic system controls. heat rejection equipment and hot gas bypass limitations.

When comparing the requirements in Section C404 of the 2015 IECC with Section 504 of the 2009 IECC for ‘Service Water Heating’, the 2015 code demonstrated:

- Improved specifications for certain categories of service hot water systems.
- Improved specification for insulation of piping.
- Improved specifications for energy consumption of pools and permanent spas.
- Added information for implementation of efficient heated water supply piping, heated water circulating and temperature maintenance system, demand recirculation controls, drain water heat recovery systems and energy requirements of portable spas.

When comparing the requirements in Section C405 of the 2015 IECC with Section 505 of the 2009 IECC for ‘Electric Power and Lighting Systems’, the 2015 code demonstrated:

- Elaborate provisions for lighting controls, which include the added requirement of occupant sensor controls and daylight responsive controls.
- Improved specifications for permissible lighting power densities for different building area types.
- Added space-by-space method of complying with the lighting requirements of the code.
- Improved specifications for non-tradable components of exterior lighting.
- Added requirements for electric transformers, electric motors as well as vertical and horizontal transportation system and equipment.

Section C406 for ‘Additional Efficiency Package Options’ has been introduced in the 2015 IECC. When showing compliance using the prescriptive path, the user is now required to meet the requirements of any one of the subsections in this section in addition to other prescriptive and mandatory requirements. Requirements of this section have been subdivided into the following categories: more efficient HVAC equipment performance; reduced lighting power density; enhanced digital lighting controls; on-site renewable energy; dedicated outdoor air system; and reduced energy use in service water system.

Section C407 for ‘Total Building Performance’ has been updated in the 2015 IECC. Not many changes have been made in this section of the 2015 code. However, since this sections of the code references other sections which are more stringent, it can be concluded that compliance with this section is more stringent.



Section C408 for ‘System Commissioning’ has been introduced in the 2015 IECC. This section has been introduced in the 2015 code by combining and elaborating several subsections of the 2009 code. In addition, several new requirements have been added in this section.

It should be noted that several provisions in the 2015 IECC could not be assessed qualitatively. A quantitative assessment is necessary to determine the stringency of these provisions. These provisions include:

- Introducing the component performance alternative in Section 402.1.5.
- Increasing the maximum permissible area limits for vertical fenestration and skylights with the addition of daylight responsive controls in Section C402.4.1.1 and Section C402.4.1.2 respectively.
- Increasing specifications for SHGC and U-value for skylights for zones provided with daylight responsive controls in Section C402.4.3.1 and Section C402.4.3.2 respectively.
- Introducing the space-by-space method for interior lighting power allowances described in Section 405.4.2.2.
- Provisions for guidelines to calculate the adjustment factor for water cooled chillers in the case of chilled water temperature being different as described in Section C403.2.3.1.

It is concluded that the provisions for commercial buildings in the 2015 IECC are more stringent than the corresponding provisions in the 2009 IECC.

Note for color coding:

	Sections modified from 2009 IECC
	Sections added to the 2015 IECC

2015 IECC Section No.		Stringency vs. 2009 IECC
C401 General	C401.1 Scope	N.A
	C401.2 Application	More Stringent
	C401.2.1 Application to replacement fenestration products	More Stringent
C402 Building Envelope Requirements	C402.1 General	More Stringent
	C402.1.1 Low-energy buildings	As Stringent
	C402.1.2 Equipment buildings	Cant Determine
	C402.1.3 Insulation component R-value based method	More Stringent
	Table C402.1.3 Opaque Thermal Envelope Component Minimum Requirements, R-value Method	More Stringent
	C402.1.4 Assembly U-factor, C-factor or F-factor-based method	More Stringent
	Table C402.1.4 Opaque Thermal Envelope Component Minimum Requirements, U-factor Method	More Stringent
	C402.1.4.1 Thermal resistance of cold-formed steel walls	More Stringent
	C402.1.5 Component performance alternative	Less Stringent
	C402.2 Specific building thermal envelope insulation requirements	More Stringent
	C402.2.1 Multiple layers of continuous insulation	More Stringent
	C402.2.2 Roof assembly	More Stringent
	C402.2.3 Thermal resistance of above-grade walls	More Stringent
	C402.2.4 Floors	More Stringent

2015 IECC Section No.			Stringency vs. 2009 IECC	
C402 Building Envelope Requirements	C402.2	C402.2.5 Slab-on-grade perimeter insulation	More Stringent	
		C402.2.6 Insulation of radiant heating systems	More Stringent	
	C402.3 Roof solar reflectance and thermal emittance		More Stringent	
		Table C402.3 Minimum Roof Reflectance and Emittance Options	More Stringent	
	C402.3.1 Aged roof solar reflectance		More Stringent	
	C402.4 Fenestration		More Stringent	
	C402.4 Fenestration		Table C402.4 Building Envelope Requirements: Fenestration	More Stringent
	C402.4.1 Maximum area		More Stringent	
		C402.4.1.1 Increased vertical fenestration area with daylight responsive controls	As Stringent	
		C402.4.1.2 Increased skylight area with daylight responsive controls	Cant Determine	
	C402.4.2 Minimum skylight fenestration area		More Stringent	
		C402.4.2.1 Lighting controls in daylight zones under skylights	More Stringent	
		C402.4.2.2 Haze factor	More Stringent	
	C402.4.3 Maximum U-factor and SHGC		More Stringent	
		C402.4.3.1 Increased skylight SHGC	Cant Determine	
		C402.4.3.2 Increased skylight U-factor	Cant Determine	
	C402.4.3.3 Dynamic glazing	More Stringent		
	C402.4.3.4 Area-weighted U-factor	Less Stringent		

2015 IECC Section No.			Stringency vs. 2009 IECC
C402 Building Envelope Requirements	C402.4 Fenestration	C402.4.4 Doors	As Stringent
	C402.5 Air leakage		More Stringent
		C402.5.1 Air barriers	More Stringent
		C402.5.1.1 Air barrier construction	More Stringent
		C402.5.1.2 Air barrier compliance options	More Stringent
		C402.5.1.2.1 Materials	More Stringent
		C402.5.1.2.2 Assemblies	More Stringent
		C402.5.2 Air leakage of fenestration	More Stringent
		Table C402.5.2 Maximum Air Leakage Rate for Fenestration Assemblies	More Stringent
		C402.5.3 Rooms containing fuel burning appliances	More Stringent
		C402.5.4 Doors and access openings to shafts, chutes, stairways and elevator lobbies	More Stringent
		C402.5.5 Air intakes, exhaust openings, stairways and shafts	More Stringent
		C402.5.7 Vestibules	More Stringent
	C402.5.8 Recessed lighting	As Stringent	
C403 Building Mechanical Systems	C403.1 General		More Stringent
	C403.2 Provisions applicable to all mechanical	C403.2.1 Calculation of heating and cooling loads	As Stringent
		C403.2.3 HVAC equipment performance requirements	More Stringent
		Table 403.2.3 (1) - (7)	More Stringent

2015 IECC Section No.				Stringency vs. 2009 IECC	
C403 Building Mechanical Systems	C403.2 Provisions applicable to all mechanical systems	C403.2.3 HVAC equipment performance requirements	Table 403.2.3(8) Minimum Efficiency Requirements: Heat Rejection Equipment	More Stringent	
			Table 403.2.3(9) Minimum Efficiency Air Conditioners and Condensing Units Serving Computer Rooms	More Stringent	
			Table 403.2.3(10) Heat Transfer Equipment	More Stringent	
			C403.2.3.1 Water cooled centrifugal chilling packages		As Stringent
			C403.2.3.2 Positive displacement chilling packages		More Stringent
		C403.2.4 HVAC system controls	C403.2.4.1 Thermostatic controls	C403.2.4.1.2 Deadband	More Stringent
				C403.2.4.1.3 Setpoint overlap restriction	More Stringent
			C403.2.4.2 Off-hour controls	C403.2.4.3.3 Automatic start capabilities	More Stringent
			C403.2.4.3 Shutoff dampers		More Stringent
			C403.2.4.4 Zone isolation		More Stringent
			C403.2.4.5 Snow- and ice-melt system controls		As Stringent
			C403.2.4.6 Freeze protection system controls		More Stringent
			C403.2.4.7 Economizer fault detecton and diagnostics (FDD)		More Stringent
		C403.2.5 Hot water boiler outdoor temperature setback control		More Stringent	
		C403.2.6 Ventilation	C403.2.6.1 Demand controlled ventilation		More Stringent
			C403.2.6.2 Enclosed parking garage ventilation controls		More Stringent
C403.2.7 Energy recovery ventilation systems			More Stringent		

2015 IECC Section No.				Stringency vs. 2009 IECC	
C403 Building Mechanical	C403.2 Provisions applicable to all	C403.2.7 Energy recovery ventilation systems	Table C403.2.7(1) Energy Recovery Requirements (Ventilation systems operating less than 8,000 hours per year)	More Stringent	
			Table C403.2.7(2) Energy Recovery Requirements (Ventilation systems operating not less than 8,000 hours/year)	More Stringent	
		C403.2.8 Kitchen exhaust systems			More Stringent
				Table C403.2.8 Maximum Net Exhaust Flow Rate, CFM Per Linear Foot of Hood Length	More Stringent
		C403.2.9 Duct and plenum insulation and sealing			More Stringent
			C403.2.9.1 Duct	C403.2.9.1.1 Low-pressure duct systems	As Stringent
				C403.2.9.1.2 High-pressure duct systems	More Stringent
		C403.2.10 Piping insulation			As Stringent
				Table C403.2.10 Minimum Pipe Insulation Thickness	More Stringent
		C403.2.11 Mechanical system commissioning and completion requirements			More Stringent
		C403.2.12 Air system design and control	C403.2.12.1 Allowable fan floor horsepower	Table C403.2.12.1(1) Fan Power Limitations	As Stringent
				Table C403.2.10.1(2) Fan Power Limitation Pressure Drop Adjustment	More Stringent
				C403.2.12.3 Fan efficiency	More Stringent
			C403.2.14 Refrigeration equipment performance		
				Table 403.2.14(1) Minimum Efficiency Requirements: Commercial Refrigeration	More Stringent

2015 IECC Section No.				Stringency vs. 2009 IECC
C403 Building Mechanical Systems	C403.2 Provisions applicable to all mechanical systems	C403.2.14 Refrigeration equipment performance	Table 403.2.14(2) Minimum Efficiency Requirements: Commercial Refrigerators and Freezers	More Stringent
		C403.2.15 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers		More Stringent
		C403.2.16 Walk-in coolers and walk-in freezers		More Stringent
		C403.2.17 Refrigerated display cases		More Stringent
	C403.3 Economizers			More Stringent
			Table C403.3(1) Minimum Chilled-water System Cooling Capacity for Determining Economizer Cooling Requirements	Cant Determine
	C403.3.1 Integrated economizers			As Stringent
	C403.3.2 Economizer heating system impact			
	C403.3.3 Air economizers			As Stringent
		C403.3.3.1 Design capacity		As Stringent
		C403.3.3.2 Control signal		More Stringent
		C403.3.3.3 High limit shutoff		More Stringent
			Table C403.3.3.3 High-limit Shutoff Control Setting for Air Economizers	More Stringent
		C403.3.3.4 Relief of excess outdoor air		As Stringent
	C403.3.3.5 Economizer dampers		More Stringent	
C403.3.4 Water economizers			-	

2015 IECC Section No.				Stringency vs. 2009 IECC	
C403 Building Mechanical Systems	C403.3 Economizers	C403.3.4 Water economizers	C403.3.4.1 Design capacity	As Stringent	
			C403.3.4.2 Maximum pressure drop	More Stringent	
	C403.4 Hydronic and multiple-zone HVAC systems controls and equipment				-
	C403.4.1 Fan control				-
			C403.4.1.1 Fan airflow control	As Stringent	
			C403.4.1.2 Static pressure sensor location	More Stringent	
			C403.4.1.3 Setpoints for direct digital control	More Stringent	
	C403.4.2 Hydronic system controls		C403.4.2.4 Part-load controls	As Stringent	
			C403.4.2.4 Boiler turndown	More Stringent	
			Table C403.4.2.5 Boiler Turndown	More Stringent	
	C403.4.3 Heat rejection		C403.4.3.1 General	As Stringent	
			C403.4.3.2 Fan speed control		As Stringent
			C403.4.3.2.1 Fan motors not less than 7.5 hp		-
			C403.4.3.2.2 Multiple-cell heat rejection equipment		More Stringent
			C403.4.3.3 Limitations on centrifugal fan open-circuit cooling towers		More Stringent
			C403.4.3.4 Tower flow turndown		More Stringent
C403.4.4 Requirements for complex mechanical systems serving multiple zones				More Stringent	
		C403.4.4.3 Fractional hp fan motors	More Stringent		

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C403 Building Mechanical Systems	C403.4 Hydronic and multiple-zone HVAC systems controls and equipment	C403.4.4	C403.4.4.6 Multiple-zone VAV system ventilation optimization control	More Stringent
		C403.4.6	Hot gas bypass limitation	More Stringent
			Table C403.4.6 Maximum Hot Gas Bypass Capacity	More Stringent
	C403.5	Refrigeration systems		More Stringent
		C403.5.1	Condensers serving refrigeration systems	More Stringent
		C403.5.2	Compressor systems	More Stringent
	C404 Service Water Heating	C404.2		Service water heating equipment performance efficiency
			Table C404.2 Minimum Performance of Water Heating Equipment	More Stringent
		C404.2.1	High input-rated service water heating systems	More Stringent
C404.4		Insulation of piping	More Stringent	
C404.5		Efficient heated water supply piping	More Stringent	
		C404.5.1	Maximum allowable pipe length method	More Stringent
			Table C404.5.1 Piping Volume and Maximum Piping Lengths	More Stringent
		C404.5.2	Water volume determination	More Stringent
C404.6		Heated-water circulating and temperature maintenance system	More Stringent	
		C404.6.1	Circulation systems	More Stringent
		C404.6.2	Heat trace systems	More Stringent
		C404.6.3	Controls for hot water storage	More Stringent

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C404 Service Water Heating	C404.7 Demand recirculation controls	More Stringent
	C404.8 Drain water heat recovery units	More Stringent
	C404.9 Energy consumption of pools and permanent spas	-
	C404.9.1 Heaters	As Stringent
	C404.9.2 Time switches	As Stringent
	C404.9.3 Covers	As Stringent
	C404.10 Energy consumption of portable spas	More Stringent
	C404.11 Service water-heating system commissioning and completion requirements	More Stringent
C405 Electrical Power and Lighting Systems	C405.1 General	More Stringent
	C405.2 Lighting controls	More Stringent
	C405.2.1 Occupant sensor controls	More Stringent
	C405.2.1.1 Occupant sensor control function	More Stringent
	C405.2.1.2 Occupant sensor control function in warehouses	More Stringent
	C405.2.2 Time switch controls	More Stringent
	C405.2.2.1 Time-switch control function	More Stringent
	C405.2.2.2 Light reduction controls	As Stringent
	C405.2.2.3 Manual controls	As Stringent
	C405.2.3 Daylight-responsive controls	More Stringent

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C405 Electrical Power and Lighting Systems	C405.2 Lighting controls	C405.2.3 Daylight- responsive controls	C405.2.3.1 Daylight-responsive control function	More Stringent
			C405.2.3.2 Sidelight daylight zone	More Stringent
			Figure 405.2.3.2(1) Daylight Zone Adjacent to Fenestration in a Wall	More Stringent
			Figure 405.2.3.2(2) Daylight Zone under Rooftop Monitor	More Stringent
			Figure 405.2.3.2(3) Daylight Zone under Sloped Rooftop Monitor	More Stringent
			C405.2.3.3 Toplight daylight zone	More Stringent
			Figure 405.2.3.3 Daylight Zone under a Roof Fenestration Assembly	More Stringent
			C405.2.4 Specific applications controls	More Stringent
			C405.2.5 Exterior lighting controls	More Stringent
			C405.4 Interior lighting power requirements	C405.4.1 Total connected interior lighting power
	C405.4.2 Interior lighting power	As Stringent		
	C405.4.2.1 Building Area Method	Table C405.4.2(1) Interior Lighting Power Allowances: Building Area Method	More Stringent	
	C405.4.2.2 Space-by-Space Method	More Stringent		
	C405.4.2.2.1 Additional interior lighting power	More Stringent		
	Table C405.4.2(2) Interior Lighting Power Allowances: Space-by- Space Method	More Stringent		
C405.5 Exterior lighting	C405.5.1 Exterior building lighting power	Table C405.5.2(1) Exterior Lighting Zone	As Stringent	
		Table C405.5.2(2) Individual Lighting Power Allowances for Building Exteriors	More Stringent	

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C405 Electrical Power and Lighting Systems	C405.6 Electrical energy consumption	As Stringent	
	C405.7 Electrical transformers	More Stringent	
		Table C405.7 Minimum Nominal Efficiency Levels for 10 CFR 431 Low-Voltage Dry-type Distribution Transformers	More Stringent
	C405.8 Electrical motors	More Stringent	
		Table C405.8(1) Minimum Nominal Full-Load Efficiency for 60 HZ NEMA General Purpose Electric Motors (Subtype 1) Rated 600 Volts or Less	More Stringent
		Table C405.8(2) Minimum Nominal Full-Load Efficiency of General Purpose Electric Motors (Subtype II) and All Design B Motors Greater than 200 HP	More Stringent
		Table C405.8(3) Minimum Average Full Load Efficiency PolyPhase Small Electric Motors	More Stringent
		Table C405.8(4) Minimum Average Full Load Efficiency For Capacitor-Start Capacitor-Run and Capacitor-Start Induction-Run Small Electric Motors	More Stringent
	C405.9 Vertical and horizontal transportation systems and equipment	More Stringent	
		C405.9.1 Elevator cabs	More Stringent
		C405.9.2 Escalators and moving walks	More Stringent
	C405.9.2.1 Regenerative drive	More Stringent	
C406 Additional Efficiency Package Options	More Stringent		
	C406.1 Requirements	More Stringent	

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C406 Additional Efficiency Package Options		C406.1.1 Tenant spaces	More Stringent	
		C406.2 More efficient HVAC equipment performance	More Stringent	
		C406.3 Reduced lighting power density	More Stringent	
		C406.4 Enhanced digital lighting controls	More Stringent	
		C406.5 On-site renewable energy	More Stringent	
		C406.6 Dedicated outdoor air system	More Stringent	
		C406.7 Reduced energy use in service water heating	More Stringent	
		C406.7.1 Load fraction	More Stringent	
C407 Total Building Performance	C407.5 Calculation procedures	C407.5.1 Building specifications	Table C407.5.1(1) Specifications for the Standard Reference and Proposed Designs	More Stringent
			Table C407.5.1(3) Specifications for the Standard Reference Design HVAC System Description	More Stringent
		C407.6 Calculation software tools		As Stringent
		C407.6.3 Exceptional calculation methods		More Stringent
C408 System Commissioning		C408.1 General		More Stringent
		C408.2 Mechanical systems and service water heating systems commissioning and completion requirements		More Stringent
		C408.2.1 Commissioning path		More Stringent
		C408.2.2 Systems adjustment and balancing		More Stringent
		C408.2.2.1 Air systems balancing		More Stringent

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C408 System Commissioning	C408.2 Mechanical systems and service water heating systems commissioning and completion requirements	C408.2.2	C408.2.2.2 Hydronic systems balancing	More Stringent
		C408.2.3	Functional performance testing	More Stringent
			C408.2.3.1 Equipment	More Stringent
			C408.2.3.2 Controls	More Stringent
			C408.2.3.3 Economizers	More Stringent
		C408.2.4	Preliminary commissioning report	More Stringent
			C408.2.4.1 Acceptance of the report	More Stringent
			C408.2.4.2 Copy of the report	More Stringent
		C408.2.5	Documentation requirements	More Stringent
			C408.2.5.1 Drawings	More Stringent
			C408.2.5.2 Manuals	More Stringent
			C408.2.5.3 Systems balancing report	More Stringent
			C408.2.5.4 Final commissioning report	More Stringent
		C408.3	Lighting systems functional test	More Stringent
			C408.3.1 Functional testing	More Stringent
			C408.3.1.1 Occupant sensor control	More Stringent
			C408.3.1.2 Time-switch control	More Stringent
	C408.3.1.3 Daylight responsive control	More Stringent		

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C408	C408.2	C408.3.2 Documentation requirements	More Stringent