2015

Montana Commercial Energy Code Summary
2012 International Energy Conservation Code

This document was compiled by the National Center for Appropriate Technology (NCAT) with input from the Montana Department of Labor and Industry.

Montana Commercial Energy Code Summary

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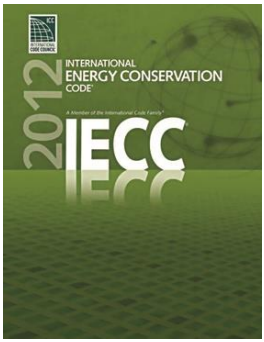
1. Introduction and General Provisions

The current Montana energy code became effective on November 7, 2014. The state adopted the 2012 International Energy Efficiency Code (IECC) without significant amendments to commercial provisions. Numerous significant amendments were made to the residential provisions. This document was produced to assist architects, engineers, and builders in understanding and complying with Montana's new commercial energy code. This document identifies key provisions and *emphasizes the changes* between the 2009 IECC and the 2012 IECC. This summary is no substitute for the full text of the code and is too brief to include all detailed exceptions and tables that are critical for a complete and thorough application of the code.

Not all code provisions are addressed by this summary!



Organization

This document is organized to follow the order of the code document itself to allow easy reference. The IECC is organized into chapters, sections, and individual code provisions. Each provision paragraph is given a reference number and title. An example is "C401.1 Scope." The "C" refers to the commercial, as opposed to residential chapters of the code. This particular reference number refers to chapter four (401). The full reference number "401.1" refers to a specific paragraph. In this handbook, the relevant code reference will be provided in the following format:

C401.1

Energy Code Development

The International Codes Council (ICC) develops and maintains a family of building codes. Montana adopts many of these codes, including the International Building Code (IBC), the International Residential Code (IRC), International Mechanical Code (IMC), and the International Energy Conservation Code (IECC). The 2012 IECC was developed by committees during 2009 and 2010 and adopted at an annual ICC Codes Conference in 2010.

The IECC is revised and published on a three-year cycle in response to changing technologies and building design approaches. Anyone may submit a code change proposal. The proposed change is reviewed by a committee of experts in that particular field. After hearing testimony from interested parties, the committee recommendations are voted up or down by member code officials.

During the code development process, industry stakeholders, contractor associations, manufacturers, and energy-efficiency advocates have opportunities to suggest changes to the code and to lobby for their particular views.

The ICC codes are developed to work together. The IECC is unique among the ICC codes in that it does not specifically address life safety and property protection. Instead, the intent of the 2012 IECC is to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building." The 2009 IECC intent addressed only "the effective use of energy."

2012 IECC Revised Intent Statement

"This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

In Montana, the state government establishes the building codes that are enforced at both the state and local code jurisdictions. The state Building Codes Advisory Council reviews all code updates, accepts testimony from stakeholders, and makes recommendations to state administration officials who make the final code language determination and establish implementation dates. City and

county jurisdictions may choose whether to enforce the codes locally but may not modify the code language. For example, if a jurisdiction chooses to not enforce the building and energy commercial provisions locally, then the State of Montana Building Codes Bureau becomes the enforcement agency for any commercial projects constructed within that jurisdiction. If a jurisdiction chooses to enforce the building code, then they must also enforce the energy code.

The code official with jurisdictional authority is responsible for conducting a plan review of a project's construction documents to determine compliance with the code. The code official is then responsible for inspecting the construction to ascertain whether the constructed building complies with the code in accordance with the construction documents.

Organization of the 2012 IECC

The 2012 edition of the IECC has been reorganized and the chapters renumbered for an easier and more user-friendly format. In previous editions there was a common chapter for scope and definitions. In the 2012 edition, the residential and commercial sections are independent and have their own scope and definition chapters. The commercial building section is now located in front of the residential section.

Commercial Section		Residential Section	
1	Scope and Administration	1	Scope and Administration
2	Definitions	2	Definitions
3	General Requirements	3	General Requirements
4	Commercial Energy Efficiency	4	Residential Energy Efficiency
5	Referenced Standards	5	Referenced Standards

Changes in the 2012 IECC language make it clear that the IECC applies not only to buildings but also to the building site, and associated systems and equipment. The term "associated systems and equipment" refers to onsite renewable energy, an exterior furnace or boiler, snowmelt systems, and exterior lighting. This change is intended to clearly establish that application of the IECC is not limited to the structure shell and its contents.

Does My Project Fall Under the Commercial or Residential Provisions of the Code?

The first part of the 2012 IECC is applicable to commercial buildings. The second part is applicable to residential buildings. Commercial buildings are defined as any building that does not meet the definition of a residential building.

Commercial Building Definition: "Not Residential"

A Residential Building Is Defined as: C202

- Detached one- and two-family dwellings
- Multiple single-family dwellings (townhouses)
- Group R-2, R-3, and R-4 buildings < four stories in height

Group R-2: Occupants are permanent in nature such as apartment houses, dormitories, non-transient hotels, fraternities, and sororities.

Group R-3: Catchall category that includes occupancies other than R-1, R-2, and R-4. Includes buildings with less than two dwelling units, care facilities with less than 5 occupants for less than 24 hours.

Group R-4: Residential care and assisted living facilities with 6 to 15 occupants.

The code details the conditions under which the energy code is to be applied.

The Commercial Energy Code is Applicable to:

- New construction C101.4
- Additions, alterations, renovations, or repairs
- Change of occupancy with greater energy demand
- When a space becomes conditioned
- Residential portion of mixed occupancy (<4 stories)

The Commercial Energy Code is Not Applicable to:

- Historic buildings

The energy code applies to additions, alterations, renovations, and repairs, as well as new construction. No changes have been made to how the energy code must be applied to existing buildings but a brief review may be useful. The energy code is not retroactive. Unaltered portions of the original building do not need to comply with the current code. A good rule of thumb is that if it is "new," then it has to meet the energy code. However, there are several exceptions.

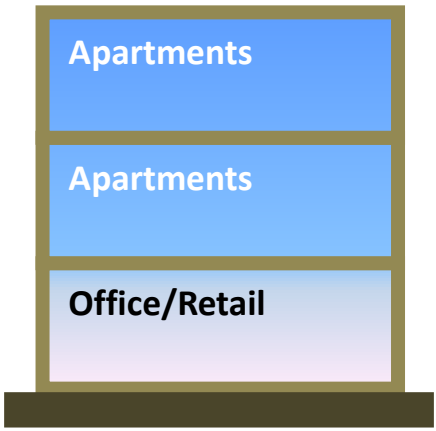
Exceptions to Existing Building Application:

C101.4.3

1. Storm window installation
2. Glass-only replacements
3. If exposed cavities are filled with insulation
4. If roof, wall, or floor cavity is not exposed
5. Reroofing roofs without insulation, if sheathing is exposed shall be insulated
6. Replacement of existing doors does not require new vestibule
7. If less than 50% of luminaires in space replaced with no greater Lighting Power Density (LPD)
8. Bulb/ballast replacement with no greater LPD

Mixed Occupancy Buildings

C101.4.6



In this three-story mixed occupancy building would the commercial or residential provisions of the energy code apply?

The building is three stories or less and a mixed occupancy so the residential provisions would apply to the second and third floors, while the first floor must comply with the commercial provisions.

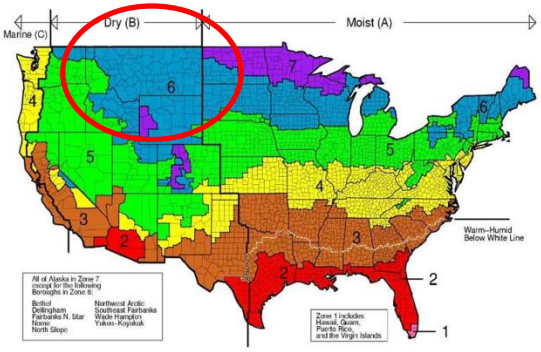
In this four-story mixed occupancy building how would the commercial or residential chapters of the energy code be applied?

The building is more than three stories above grade and is a mixed occupancy. The commercial chapters of the energy code would apply to all floors. Envelop requirements specific to Group R-occupancies are provided within the commercial provisions.

Climate Zone

C301

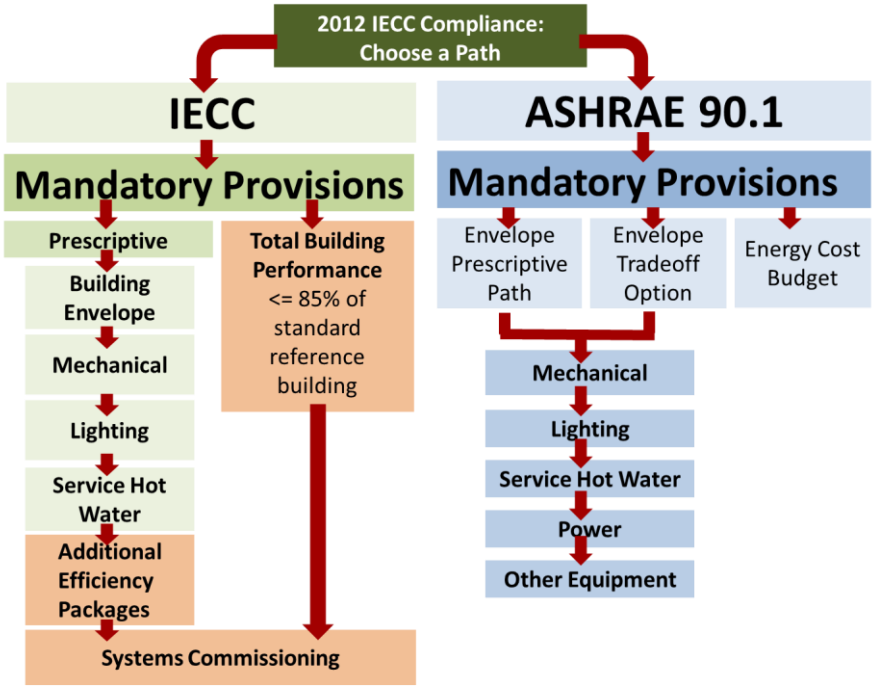
Many code provisions are dependent on climate zone. The climate zones are unchanged from the 2009 IECC. All of Montana is in Zone 6. Only values applicable to climate Zone 6 will be addressed in this summary.



Compliance Paths

Commercial buildings must comply with either the 2012 IECC or ASHRAE Standard 90.1-2010. The purpose of multiple pathways is to provide flexibility in application of the energy code. The designer must select either Chapter Four of the 2012 IECC or ASHRAE 90.1-2010 for building compliance path for the entire building. The focus of this summary is the compliance paths within the Chapter Four of the IECC. Within the IECC, there are two compliance options: the *Prescriptive* and the *Total Building Performance* compliance paths. The advantage of the Total Building Performance path over the Prescriptive Path is that tradeoffs are allowed between the envelope, mechanical systems, lighting

systems, and service hot-water systems. ASHRAE 90.1-2010 has two similar compliance paths. Once a designer determines whether to apply the IECC or ASHRAE 90.1 to a building, then the entire building must comply with the provisions of that document.



Total Building Performance C407

Section C407 of the IECC details how to comply using the total building performance path. However, the general provisions include a critical change in this edition of the IECC. In the previous edition of the code, the proposed building energy cost had to be equal to or less than the standard reference design. In the 2012 IECC, the proposed building energy cost must be equal to or less than 85% of the standard reference design. As in the previous edition, the code's mandatory provisions must be met when applying the Total Building Performance path. The code does not allow the application of the Total Building Performance path to additions, alterations, or repairs.

Major Changes

The heart of the commercial provisions is found in Chapter 4. The diagram on this page lists the eight sections of Chapter Four and suggests which sections saw the most significant changes. There were significant changes to the envelope, mechanical, and power and lighting sections. As mentioned above, there was one significant change to the total building performance section. There are new sections for "Additional Efficiency Packages" and "System Commissioning."

Code Change Summary		Minor Changes	Significant Changes	New Section
C401	General			
C402	Envelope			
C403	Mechanical			
C404	Service Water Heating			
C405	Power and Lighting			
C406	Additional Efficiency Packages			
C407	Total Building Performance		C401 85%	
C408	System Commissioning			

2. Envelope Requirements

Tables C402.2 (Opaque Thermal Envelope) and C402.3 (Fenestration) establish the prescriptive envelope requirements. As an alternative to Table C402.2, a table of assembly U-factors (Table C402.1.2) may be used. Commercial buildings or portions of commercial buildings enclosing Group R occupancies are to use the "Group R" column. All other occupancies are to use the "All Other" column.

In the table on the next page, the code requirements that are more stringent in the new code are shaded dark blue with a white font. Values that are less stringent are shaded dark green with a white font.

TABLE C402.2 OPAQUE THERMAL ENVELOPE REQUIREMENTS		
Climate Zone 6	All Other	Group R
Roofs		
Insulation above deck	R-30ci	R-30ci
Metal buildings (with R-5 thermal blocks) [a, b]	R-25 + R-11 LS	R-25 + R-11 LS
Attic and other	R-49	R-49
Walls, Above Grade		
Mass	R-13.3ci	R-15.2ci
Metal building	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-7.5ci	R-13 + R-7.5ci
Wood framed and other	R-13 + R-7.5 or R-20 + R-3.8ci	R-13 + R-7.5 or R-20 + R-3.8ci
Walls, Below Grade		
Below-grade wall[d]	R-7.5ci	R-7.5ci
Floors		
Mass	R-12.5ci	R-12.5ci
Joist/framing	R-30	R-30[e]
Slab-on-Grade Floors		
Unheated slabs	R-10 for 24 below	R-15 for 24 below
Heated slabs[d]	R-15 for 36 below	R-20 for 48 below
Opaque Doors		
Swinging	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75

Footnotes to TABLE C402.2 OPAQUE THERMAL ENVELOPE REQUIREMENTS

LS = Liner System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.

b. Where using R-value compliance method, a thermal spacer block shall be provided; otherwise, use the U-factor compliance method in Table C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft^2 °F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

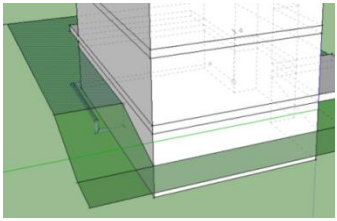
e. Steel floor joist systems shall be insulated to R-38.

The insulation requirements for metal building and wood-frame walls have increased. The continuous insulation component for metal building walls has changed from R-5.6 to R-13. Continuous insulation is now mandatory for wood-frame walls. R-21 cavity insulation in wood-frame walls without continuous sheathing is no longer an option in the prescriptive approach. Wood-frame walls must either provide R-13 cavity insulation plus R-7.5 continuous insulation or R-20 cavity insulation plus R-3.8 continuous insulation.

Requirements for heated slab insulation have changed. The R-15 insulation around the perimeter of the slab has increased from 24 inches to 36 inches combined vertical and horizontal dimension. Perimeter insulation is not required when the slab-on-grade is greater than 24 inches below the finished exterior grade. It should be noted that the IMC (1209.5.1) requires slabs-on-grade used for radiant heating to have at least R-5 insulation under the entire slab.

Above- and Below-Grade Wall Definition C402.2.2

Early printings of the 2012 IECC included a general definition for above- and below-grade walls in Chapter 2. Those definitions are omitted in later printings. In these later editions, the correct definitions are included in Chapter 4. Walls that are more than 15% above grade are considered above-grade walls. For example, if 16% of a wall is above-grade the entire wall, including the portion



below grade, is considered an above grade wall when applying the provisions of Chapter 4. This distinction becomes important in determining above grade wall area for purposes of calculating the vertical fenestration limit.

Radiant Panels to Be Insulated with R-3.5 C402.2.8

A radiant panel is a floor, wall, or ceiling assembly designed for sensible heating. A radiant panel may or may not be a slab. Radiant panels must be insulated with at least R-3.5. The table below notes that slabs up to 24" below grade must comply with the prescriptive requirements for slab-on-grade floors of Table C402.2. This change means that all radiant floor slabs must be insulated to at least R-3.5. It should be noted that the IMC (1209.5.1) requires slabs-on-grade used for radiant heating to have at least R-5 insulation under the entire slab.

Radiant Panel for Sensible Heating of Indoor Space	Must Comply with U and R-Value Tables	Must Comply with R-3.5
Slab in contact with ground <=24" below grade	Yes	Yes
Slab in contact with ground >24" below grade	No	Yes
Slab not in contact with ground	No	Yes
Not a slab	No	Yes

Fenestration Code Values C402.3

The fenestration categories included in the fenestration table have changed. U-factors have become more stringent with the exception of operable non-metal frame units when the requirement has been relaxed. In the previous edition of the code, Solar Heat Gain Coefficient (SHGC) requirements were not applicable for windows with projection factors of 0.25 or greater. That is no longer the case in the new code. SHGC adjustments have also been added to the code. An area-weighted average is permitted to satisfy the U-factor requirements of each fenestration product category listed. Fenestration products from different categories listed may not be combined in calculating the area-weighted average U-factor.

TABLE C402.3 BUILDING ENVELOPE REQUIREMENTS: FENESTRATION			
2012 Categories	Climate Zone 6		2009 Categories
Vertical fenestration	2012 IECC	2009 IECC	Vertical fenestration
U- factor			
Fixed fenestration	0.36		
Operable fenestration	0.43		
		0.35	Non-Metal Frame
		0.45	Metal Frame Curtain Wall/Storefront
		0.55	Metal Frame - All Other
Entrance doors	0.77	0.80	
SHGC			
SHGC	0.40	0.40	
Skylights			
U-factor	0.50	0.60	
SHGC	0.40	0.40	

According to the IECC U-factors of windows, skylights, and doors are to be determined per the National Fenestration Rating Council (NFRC) standards. Products lacking such an NFRC certification label must use default values included in Chapter 3 of the IECC. These default values generally do not meet the requirements of the prescriptive compliance path. Similarly, if a fenestration product does not have an NFRC certification label that includes the solar heat gain coefficient or visual transmittance, then the appropriate default table in Chapter 3 of the code is to be applied.

Maximum Vertical Fenestration Area C402.3.1

The vertical fenestration area may not exceed 30% of the gross above-grade-wall area. For purposes of this calculation, the fenestration area does not include opaque doors or opaque spandrel panels. Forty percent of the gross above-grade-wall area for fenestration is permitted if three conditions are met: at least 50% of conditioned floor area is within daylight zones, automatic daylighting controls are installed, and visual transmittance of vertical fenestration is ≥ 1.1 times the SHGC.

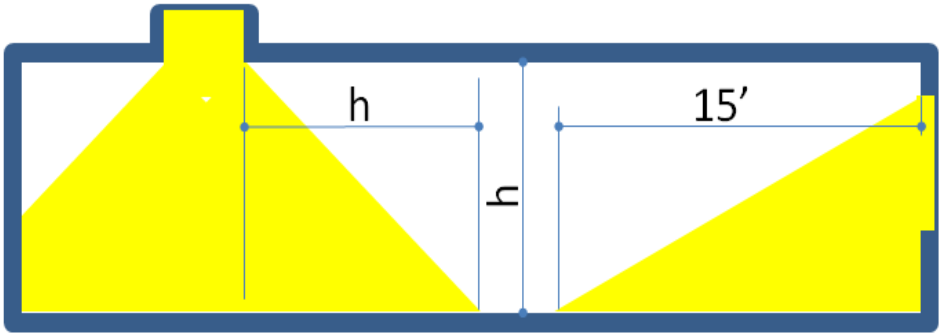
This calculation is based on the gross above-grade wall area including all walls between conditioned space and unconditioned space or outdoors. Gross above-grade wall area includes walls that are greater than 15% above grade. The total fenestration area includes frame and glazing.

Skylight Maximum Fenestration Area C402.3.1

The total skylight area must be less than or equal to 3% of the gross roof area. The skylight area in this calculation is the total assembly area including the frame. The skylight area may be up to 5% of the gross roof area if automatic daylighting controls are installed in daylight zones under skylights. New minimum skylight area requirements for big box stores and warehouse-type spaces in the 2012 IECC do not apply to the Montana climate zone.

Definition of Daylight Zone C202

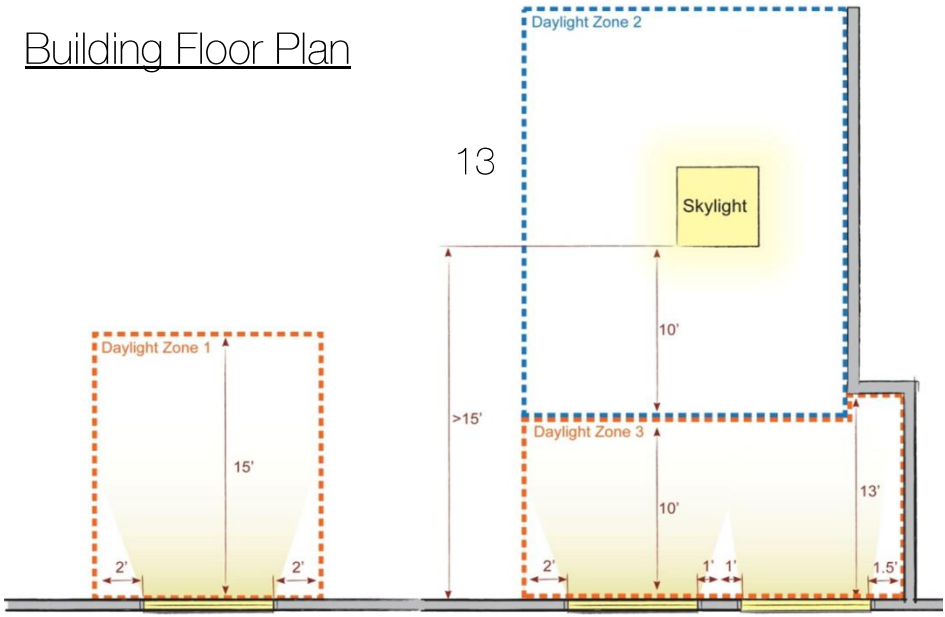
The definition of a daylight zone is unchanged from the previous edition of the IECC. The daylight area associated with a skylight includes the area directly under the skylight, its footprint, plus a distance equal to the floor to ceiling height beyond the skylight footprint. Adjacent to vertical glazing, the daylight zone extends 15’ into the building and 2’ to either side of the fenestration. A ceiling-height, opaque partition becomes the boundary of the daylight zone.



Skylight Daylighting Zone

Building Section

Building Floor Plan



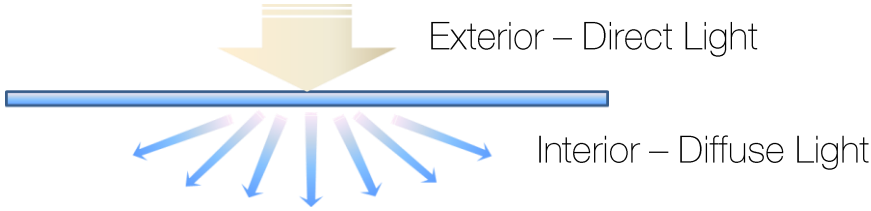
Vertical Fenestration Daylighting Zone

Source: Kenergy

Haze Factor C402.3.2.2

Skylights in offices, storage, automotive service, manufacturing, non-refrigerated warehouse, retail store, and distribution/sorting areas must have a glazing material or diffuser with a measured haze factor greater than 90%.

There is an exception for skylights designed to exclude direct sunlight by use of fixed or automated baffles or by the geometry of the skylight and light well. The haze factor is the percentage of light that becomes diffuse as it passes through the glazing. In other words, the skylight glazing absorbs direct light, which is then emitted on the inside as diffuse light.



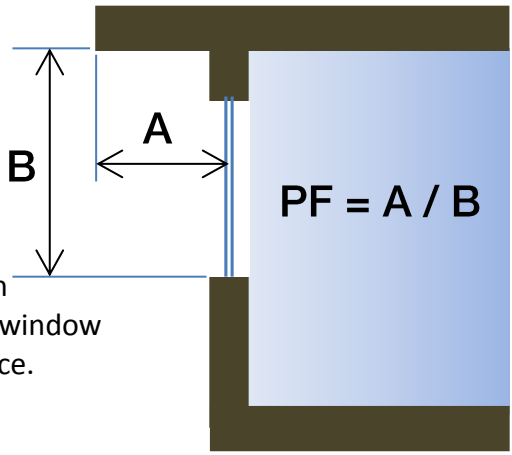
Skylight Requirements Summary

The following table summarizes the energy code skylight requirements:

Skylight Requirements Summary			
	Maximum % of Roof Area*	U-factor	SHGC
Zone 6 Provisions	**3%**	**0.5**	**0.4**
with Automatic Daylighting Controls	**5%**	**0.75**	**0.6**
	* - Gross roof area		

Vertical Fenestration SHGC Adjustment C402.3.3.1

The SHGC indicates the percent of solar radiation that is transmitted into the building as heat. Table C402.3 includes maximum SHGC values. The values from that table may be adjusted for a specific fenestration unit based on that unit's projection factor (PF). The PF is based on the window sill height and the overhang distance.



Vertical Fenestration Requirements Summary

The following table summarizes the energy code vertical fenestration requirements:

Vertical Fenestration Requirements Summary								
		U-factor			SHGC		VT	
	% of Wall Area*	Fixed	Operable	Entrance Doors	Within 45° of North	Other Orient.	Within 45° of North	Other Orient.
Zone 6 Requirements								
PF < 0.2	**30%**	**0.36**	**0.43**	**0.77**	**0.40**	**0.40**	**N/A**	**N/A**
0.2 <= PF < 0.5	**30%**	**0.36**	**0.43**	**0.77**	**0.44**	**0.48**	**N/A**	**N/A**
PF >= 0.5	**30%**	**0.36**	**0.43**	**0.77**	**0.48**	**0.64**	**N/A**	**N/A**
Greater than or equal to 50% floor area in Daylight Zones with Automatic Controls								
PF < 0.2	**40%**	**0.36**	**0.43**	**0.77**	**0.40**	**0.40**	**0.44**	**0.44**
0.2 <= PF < 0.5	**40%**	**0.36**	**0.43**	**0.77**	**0.44**	**0.48**	**0.48**	**0.528**
PF >= 0.5	**40%**	**0.36**	**0.43**	**0.77**	**0.48**	**0.64**	**0.53**	**0.704**
* - Gross above-grade wall area								

Air Barriers C402.4.1

The 2012 IECC includes significant new air barrier requirements. These changes are quite extensive so only the most significant will be mentioned here. The mandatory air barrier must be continuous for all assemblies that make up the thermal envelope. All joints must be sealed. All penetrations must be sealed securely. The materials of the air barrier must be able to withstand the positive and negative pressure of the wind, stack effect, and mechanical ventilation. The integrity of the air barrier must be maintained across penetrations such as recessed light fixtures. The energy code details how the joints and seams are to be sealed. The continuous air barrier must comply either through materials, assemblies, or by building testing.

Air Barrier Compliance Options

C402.4.1.2.1 Materials or
C402.4.1.2.2 Assemblies or
C402.4.1.2.3 Building Testing

Air Barrier Requirements

- Where placement allowed:
  - On inside of building envelope (Based on the Montana amendment to the air barrier definition.)
  - Located within assemblies composing envelope OR
  - Any combination
- Must be continuous for all assemblies that are a part of the thermal envelope and across joints and assemblies
- Joints and seams must be sealed (per C402.4.2)
- Recessed lighting to comply with C402.4.8
- Where objects are installed that penetrate the air barrier, make provisions to maintain the air barrier's integrity

The energy code specifies the required air permeability characteristics of *materials* that meet the air barrier requirements. Materials must have an air permeance ≤ 0.004 cfm/ft^2 under a pressure differential of 0.3 inches water gauge. The energy code lists 15 materials that are deemed to comply. The code sets air permeability limits for *assemblies* that may be used to comply with the air barrier requirement. For more information about air barriers, refer to the Air Barrier Association of America. Assemblies of materials and components (sealants, tapes, etc.) must have an average air leakage ≤ 0.04 cfm/ft^2 at 0.3 inches water gauge.

A building may comply with the air barrier requirement through a tightness test. The air leakage rate of the completed building must be tested and confirmed to not exceed 0.40 cfm/ft^2 of building envelope at a pressure differential of 0.3 inches water (75 Pa) to comply through tightness testing.

Source: Energy Conservatory

Building tightness testing with a blower door is a common practice in residential buildings. A typical residential blower door fan has a capacity of about 5,000 cfm at 75 Pa. Multiple blower doors can be combined to test larger buildings. Four typical residential blower door fans should be able to test a small building of about 20,000 ft^2. The protocol for commercial building envelope tightness testing differs significantly from the residential protocols. One key difference is that residential building tightness tests are performed at 50 Pa, while the commercial building tests are performed at 75 Pa according to energy code.

Air Leakage of Fenestration Assemblies C402.4.3

The air leakage of fenestration assemblies must meet the provisions of Table C402.4.3.

Fenestration Assembly	cfm/ft^2	Test Procedure
Windows, sliding glass doors, and swinging doors	**0.2**	**AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400**
Skylights - with condensation weepage openings	**0.3**	
Skylights – all other	**0.2**	
Curtain walls and storefront glazing	**0.06**	**NFRC 400 or ASTM E283 at 1.57 psf**
Commercial glazed swinging entrance doors	**1**	
Revolving doors	**1**	
Garage doors	**0.4**	**ANSI/DASMA 105, NFRC 400, or ASTM E283 at 1.57 psf**
Rolling doors	**1**	

Exceptions:
Field-fabricated fenestration assemblies
Fenestration in buildings that meet the building test for air barrier compliance

3. Building Mechanical Systems and Service Water Heating

Section C403 addresses the requirements for commercial building mechanical systems. It is organized into mandatory requirements applicable to all mechanical systems and requirements specific to either simple or complex HVAC systems. The following table identifies where the most significant changes have occurred in the mechanical provisions.

	Major Changes to Mechanical Systems	Minor Changes	Significant Changes	Remarks
1	**HVAC Load Calculations**			
2	**Equipment and System Sizing**			
3	**HVAC Equipment Performance**			Many Changes to Tables
4	**HVAC System Controls**			Auto Start Expanded
5	**Ventilation**			Demand Control Expanded
6	**Energy Recovery Ventilation**			Energy Recovery Expanded
7	**Duct/Plenum Insul. & Sealing**			
8	**Piping Insulation**			Modified Table, Protection
9	**HVAC System Commissioning**			New Section
10	**Air System Design and Control**			
11	**Heating Outside a Building**			

Mandatory Minimum HVAC Equipment Tables C403.2.3

The series of minimum performance tables in this section have been updated and, in some cases, new categories have been added. In some tables, part-load performance of commercial HVAC systems was represented as integrated part-load value (IPLV) until January 1, 2010. Then a new methodology was adopted and defined as Integrated Energy Efficiency Ratio (IEER), which is now used in several of the tables. IEER is the cooling part-load energy-efficiency ratio for commercial unitary air conditioning and heat pump equipment on the basis of weighted operation at various load capacities. In its most simplistic form, the IEER is calculated by operating the system at four different capacities and applying a formula.

There is insufficient space in this summary to include all of the tables but the tables and their major modifications are listed in the following table:

HVAC Equipment Performance Requirements Tables

Table	Changes
Table C403.2.3(1) **Minimum Efficiency Requirements: Electrically Operated Unitary Air Conditioners and Condensing Units.**	Size categories have been modified.
	A new column differentiates electric resistance from other heating types.
	IPLV values have been replaced by IEER.
Table C403.2.3(2) **Minimum Efficiency Requirements: Electrically Operated Unitary and Applied Heat Pumps**	Added IEER values.
	Higher SEER ratings for through-the-wall units.
	New heating rating for small-duct, high-velocity, air-cooled, heat pumps.
	HSPF factors for heat pumps in heating mode replaced by COP values.
	New categories have been added for water-source and ground-source heat pumps.
Table C403.2.3(3) **Minimum Efficiency Requirements: Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Packaged Vertical Air Conditioners, Single Vertical Heat Pumps, Room Air Conditioners and Room Air-Conditioner Heat Pumps**	Higher EER values for PTAC and PTHP units.
	New Categories and Ratings for single-package vertical air conditioners (SPVAC) and single-package vertical heat pumps (SPVHP).
	The energy efficiency ratio (EER) Values for PTACs and packaged terminal heat pumps have been increased.
Table 403.2.3(4) **Warm Air Furnaces and Combination Warm Air Furnaces/Air-Conditioning Units, Warm Air Furnaces and Unit Heaters, Minimum Efficiency Requirements**	Table unchanged.
TABLE C403.2.3(5) **Minimum Efficiency Requirements: Gas- and Oil-Fired Boilers**	Category reorganization.
	Some modest efficiency increases.
Table C403.2.3(6) **Minimum Efficiency Requirements: Condensing Units, Electrically Operated**	Category reorganization.
	Some modest efficiency increases.
Table C403.2.3(7) **Minimum Efficiency Requirements: Water Chilling Packages**	Table unchanged.
Table C403.2.3(8) **Minimum Efficiency Requirements: Heat Rejection Equipment**	Entirely new table.
Table C403.2.3(9) **Heat Transfer Equipment**	Entirely new table.

Automatic Start Capabilities C403.2.4.3.3

A change in the code now requires that automatic start controls be provided for each HVAC system. The controls must be capable of automatically adjusting the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy. This will reduce the amount of time that unoccupied spaces are maintained at occupied setpoints.

US DOE Building Codes University

Demand Controlled Ventilation C403.2.5.1

US DOE Building Codes

Another major change in HVAC mandatory controls requirements has to do with demand controlled ventilation. Demand controlled ventilation provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than the design occupancy. The new code requires that demand controlled ventilation be provided for each zone with spaces greater than 500 ft² and with an average occupant load greater than 25 people/1,000 ft². This applies to HVAC systems that have an air-side economizer or an automatic modulating control of the outdoor air damper or a design outdoor airflow greater than 3,000 cfm. The following table lists a number of important exceptions.

Exceptions:

- Systems with energy recovery per C403.2.6
- Multiple zone systems without direct digital control of single zones communicating with central control panel
- Systems with design outdoor airflow < 1,200 cfm
- Spaces where supply airflow rate minus any makeup or outgoing transfer air requirement < 1,200 cfm
- Ventilation provided for process loads only

Energy Recovery Ventilation Systems C403.2.6

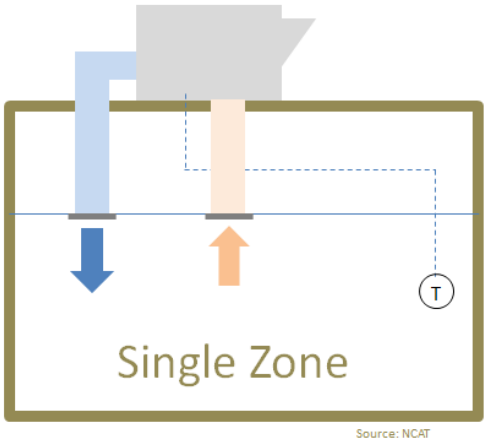
Energy recovery ventilation (ERV) systems employ air-to-air heat exchangers to recover energy from exhaust air for the purpose of preheating, precooling, humidifying, or dehumidifying outdoor ventilation air prior to supplying the air to a space, either directly or as part of an HVAC system. The requirements for ERV systems have changed. The major change is the addition of a table which replaces a single fixed trigger point of 5,000 cfm and 70% outside air. The code now requires that the exhaust air recovery efficiency must be greater than or equal to 50%. When an air economizer is required, the energy recovery system must include a bypass or controls that permit operation of the economizer according to provisions for complex HVAC systems.

TABLE C403.2.6 ENERGY RECOVERY REQUIREMENT

	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE					
	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)					
Climate Zone 6B	≥ 11000	≥ 5500	≥ 4500	≥ 3500	≥ 2500	≥ 1500

Simple HVAC Systems C403.3

A number of provisions are applicable to either simple or complex HVAC systems. Simple systems usually serve a single zone with one control for the system. Examples of simple systems are single-zone warm air furnaces, packaged terminal air conditioners, packaged terminal heat pumps, unitary air conditioners and condensing units, and two-pipe heating systems with no cooling.



Source: NCAT

Simple systems must be purchased as new single-zone unitary equipment. If not, then the system must use the provisions for complex systems. The IECC commentary from the ICC clarifies that only newly purchased equipment may be classified as “simple” for the purposes of this section of the code.

Simple System Economizers C403.3.1

The significant change for simple HVAC system economizers lies in the table which expands their applicability. Economizers are now required on smaller systems. Previously the limit was 54,000 Btu/h. The new limit for climate zone 6 is 33,000 Btu/h. To close a potential loophole in the code, a footnote states that the total capacity of all systems without economizers can’t exceed 300,000 Btu/h per building, or 20 percent of its air economizer capacity, whichever is greater. As usual in the code, there are a number of exceptions. The exceptions are not included here.

TABLE C403.3.1(1) ECONOMIZER REQUIREMENTS

	ECONOMIZER REQUIREMENT
Climate Zone 6	**Economizers on all cooling systems ≥ 33,000 Btu/h**

Simple System Economizer High-Limit Shutoff C403.3.1.1.3

Air economizers must be capable of automatically reducing the outdoor air intake to the design minimum outdoor air quantity when the outdoor air intake will no longer reduce cooling energy usage. High-limit shutoff control types are to be chosen from the table shown.

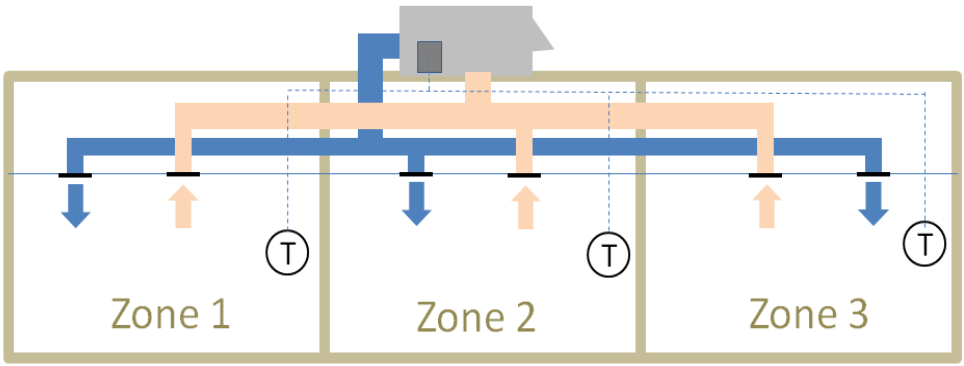
TABLE C403.3.1.1.3(1) HIGH-LIMIT SHUTOFF CONTROL OPTIONS FOR AIR ECONOMIZERS		
CLIMATE ZONES	ALLOWED CONTROL TYPES	PROHIBITED CONTROL TYPES
Climate Zone 6	Fixed dry bulb	Fixed enthalpy
	Differential dry bulb	
	Electronic enthalpy[a]	
	Differential enthalpy	
	Dew-point and dry-bulb temperatures	

a. Electronic enthalpy controllers are devices that use a combination of humidity and dry-bulb temperature in their switching algorithm.

Simple system economizers must be capable of relieving excess outdoor air during air economizer operation to prevent over-pressurizing the building. The relief air outlet is to be located to avoid recirculation of the exhaust air back into the building.

Complex HVAC Systems C403.4

All systems that do not qualify as simple HVAC systems fall under the complex system requirements. Systems that fall under this category typically include variable-air-volume systems, systems serving more than one zone, four-pipe systems, two-pipe changeover systems, and hydronic heating and water-chilling packages.



Source: NCAT

Complex System Economizers Design Capacity 403.4.1.1

Water economizer systems must be capable of cooling supply air by indirect evaporation and providing up to 100% of the expected cooling system load at outdoor air temperatures of 50°F dry bulb and 45°F wet bulb and below. An exception allows water economizer systems where dehumidification requirements can't be met at the stated outdoor air temperatures to meet the code by satisfying 100% of the expected cooling load at 45°F dry bulb/40°F wet bulb.

Exceptions:

- Water economizer systems where dehumidification requirements can't be met at 50°F dry bulb/45°F wet bulb.
- Satisfy 100% of expected cooling load at 45°F dry bulb/40°F wet bulb.

Complex System Economizers Maximum Pressure Drop C403.4.1.2

Unlike airside economizers, water economizers have parasitic energy losses that reduce the cooling energy savings. One of these losses comes from possible increases in pumping energy. This requirement attempts to limit those losses. Precooling coils and water-to-water heat exchangers used in water economizer systems must have either a waterside pressure drop of < 15 feet of water, or a secondary loop created so the coil or heat exchanger drop isn't seen by circulating pumps when system is in normal cooling mode.

Complex System Integrated Economizer Control C403.4.1.3

In the 2012 IECC, economizers must be integrated with the cooling system equipment and provide partial cooling even when additional mechanical cooling is required. This provision prohibits the system from reverting to total mechanical cooling when the economizer capacity is exceeded. In other words, any partial cooling by the economizer must be utilized. There are two exceptions.

Exceptions:

- Direct expansion systems with controls that reduce the quantity of outdoor air required to prevent coil frosting at lowest step of compressor unloading, provided this lowest step is ≤ 25% of total system capacity
- Individual direct expansion units with rated cooling capacity < 54,000 Btu/h and using nonintegrated economizer controls that preclude simultaneous operation of the economizer and mechanical cooling

Complex System Heating System Impact C403.4.1.4

The HVAC system design and economizer controls must prevent economizer operation from increasing the building heating energy use during normal operation.

Exception:
Economizers on VAV systems that cause zone-level heating to increase due to a reduction in supply air temperature.

Complex System Variable-Air-Volume Fan Control C403.4.2

Smaller VAV fan motor sizes are now being covered by the energy code. The minimum fan motor size that requires variable flow capability decreased from 10 HP to 7.5 HP. The fan must have controls or devices to result in fan motor demand less than or equal to 30% of their design wattage at 50% of design airflow. The options for control under this provision include:

- Driven by a mechanical or electrical variable speed drive OR
- Driven by a vane-axial fan with variable-pitch blades OR
- Have controls or devices to result in fan motor demand ≤ 30% of their design wattage at 50% of design airflow

This provision is primarily targeting systems with direct digital control (DDC) of individual zone boxes that report to a central panel.

Service Water Heating

The minimum performance of service water-heating equipment is detailed in Table C404.2 Minimum Performance of Water-Heating Equipment. No changes were made in this table or its values in the 2012 edition of the IECC. This table is too large to include in this summary.

Temperature Controls C404.3

Controls are required to allow a setpoint of 110° F for dwelling units and 90° F for other occupancies. The outlet temperature in public lavatories must be limited to 110° F.

Pipe Insulation C404.5

Automatic-circulating hot water and heat-traced systems must have 1" of insulation having a conductivity of no less than 0.27 Btu per inch/h^2 x ft^2 x °F.

Hot Water System Controls C404.6

Circulating hot-water pumps and heat trace must be arranged to turn-off either automatically or manually when there is limited hot water demand.

Pools and Inground Permanently Installed Spas C404.7

Vapor-retardant covers are required for heated pools and in-ground, permanently installed spas. There is an exception for systems with 70% of their energy derived from site-recovery or solar energy.

There are significant changes to the lighting section of the energy code. There is an important general exception for dwelling units.

Exception for Dwelling Units C405.1

Dwelling units within commercial buildings as defined in the IECC are not required to comply with the general requirements of this chapter if at least 75% of the permanently installed light fixtures, other than low-voltage lighting, are fitted for and contain only high-efficacy lamps. High-efficacy lamps are defined as compact fluorescent lamps, T-8 or small diameter linear fluorescent lamps, or lamps that meet the minimum lumens/watt value in the definitions.

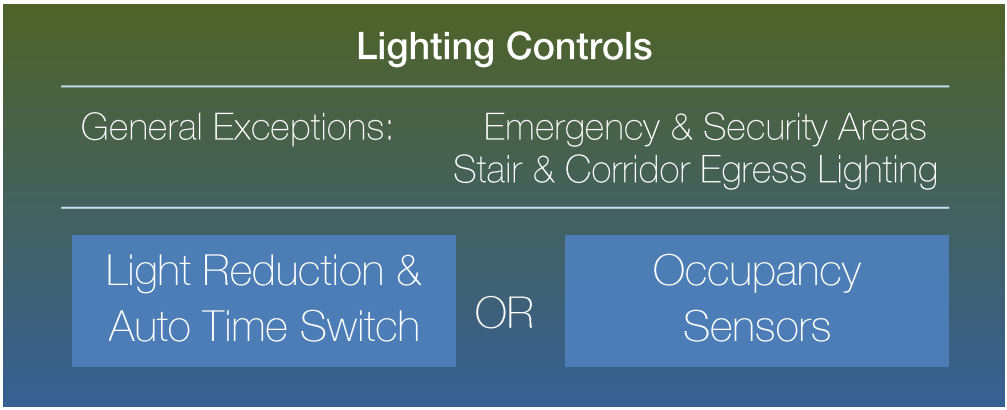
Lighting Requirements Overview

Complying with the energy code requires meeting the lighting power density limit and applying the appropriate manual, time switch, occupancy sensors, daylight zone controls, and controls specific to particular applications. First, we will address lighting controls. The purpose of lighting controls is to turn off lights when they are not needed.

Lighting Controls Overview C405

There are no changes to the basic code language about interior manual lighting controls. Each area enclosed by walls or floor-to-ceiling partitions must have at least one manual control for the general lighting serving that area. Each area that is required to have a manual control must also allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent. Three exceptions to this requirement have been added to those that were present in the previous edition. Light-reduction controls need not be provided if the area has only one luminaire with rated power less than 100 watts. Other conditions where light reduction is not required include if the area is controlled by an occupant sensor, or for the following spaces, corridors,

equipment rooms, storerooms, restrooms, public lobbies, and electrical or mechanical rooms.



The energy code now has revised provisions for automatic time-switch controls, occupancy sensors, and daylight zone controls. The provisions for additional lighting controls have exceptions for sleeping units, spaces where patient care is directly provided, spaces where an automatic shutoff would endanger occupant safety or security, and lighting intended for continuous operation.

Additional Lighting Controls C405.2.2

"Additional Lighting Controls" is a new section although most of the control strategies are retained from the earlier code. The 5,000 ft^2 threshold for automatic controls has been eliminated and the maximum override control area has been reduced from 25,000 ft^2 to 20,000 ft^2. Emergency egress lighting does not need to be controlled by an automatic time switch. Lighting in spaces controlled by occupancy sensors is also exempted. The automatic time switch control devices must include a readily accessible override switch located where the lights controlled by the switch are visible or the switch must provide a mechanism that announces the area controlled by the switch. The override switch must allow manual operation and any individual override switch must control the lighting for a maximum area of 5,000 ft^2. There are also a number of exceptions that apply to malls, arcades, auditoriums, single-tenant retail spaces, industrial facilities, and arenas.

Light Reduction and Automatic Time Switch Controls

C405.2.1 & C405.2.2

Minimum 50% Reduction with Approved Methods:

- Controlling of lamps or fixtures
- Dual switching
- Middle lamp independent switching
- Switch each fixture or lamp

Exceptions:

1. Areas 1 fixture <100 watts
2. Corridors, equipment rooms, storerooms, restrooms, public lobbies, electrical/mechanical rooms
3. Sleeping unit
4. Spaces with < 0.6 watts/ft^2
5. Daylight areas with auto controls

Automatic Time Switch Controls:

Exceptions

1. Sleeping Units
2. Direct patient care spaces
3. Occupant safety endangered
4. Continuous operation
5. Emergency egress

Override switch required except in various exceptions for malls, arcades, auditoriums, single-tenant retail spaces, industrial spaces, and arenas.

Occupancy Sensors C405.2.2.2

This provision targets spaces that are often unoccupied. Occupancy sensors are required in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, and other spaces 300 ft^2 or less enclosed by floor-to-ceiling height partitions.

These automatic control devices must be installed to turn off lights within 30 minutes of all occupants leaving the space, and must either be manual-on or controlled to automatically turn the lighting on to not more than 50 percent power.

Occupancy Sensors

Required in:

- Classrooms
- Conference/meeting rooms
- Employee lunch/break
- Private offices
- Restrooms
- Storage rooms
- Janitorial closets
- Other rooms <=300 ft^2

Not Required in:

- Direct patient care spaces
- If occupant safety endangered
- Continuous operation
- Emergency egress

Installation Provisions:

- Turn off within 30 min. manual-on or automatic to < 50%
- "Full-on" ok in:
  - Public corridors
  - Stairways
  - Restrooms
  - Primary entrance areas
  - Safety or security endangered

Full automatic-on controls are permitted to control lighting in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.

Daylight Zone Control C405.2.2.3

Daylight zones for energy efficiency were introduced in the 2009 IECC. The 2012 IECC adds the option for automatic controls in the daylighting zone and a maximum control zone area of 2,500 ft^2. There is an exception that states daylight zones enclosed by walls or ceiling height partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.

Stepped or dimming controls are the allowed methods to provide automatic daylight controls. Set-point and other controls for calibrating the lighting control device must be readily accessible. Daylighting controls must be capable of automatically reducing-lighting power in response to available daylight. When used, continuous dimming must allow lighting power to be reduced to less than 35% of rated power. Stepped dimming must provide a minimum of two control channels per zone and be installed in a manner such that at least one control step is between 50 percent and 70 percent of design lighting power and another control step is no greater than 35 percent of design power.

Manual controls must be installed in daylight zones unless automatic controls are installed.

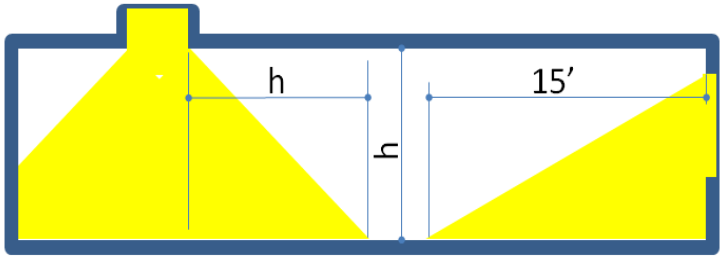
Daylight Zones Defined C202

Daylight zones for energy efficiency were introduced in the 2009 IECC. The definition of a daylight zone is unchanged from the previous edition of the IECC. As the diagram suggests, the daylight area under the skylight includes the area directly under the skylight plus the floor-to-ceiling height distance beyond the skylight footprint. Adjacent to vertical glazing, the daylight zone extends 15’ into the building and 2’ to either side. A ceiling height opaque partition becomes the boundary of the daylight zone. Daylight zones enclosed by walls or ceiling height

partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.

Daylight Zone Diagrams

Section



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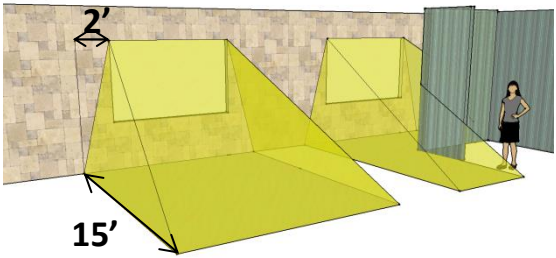

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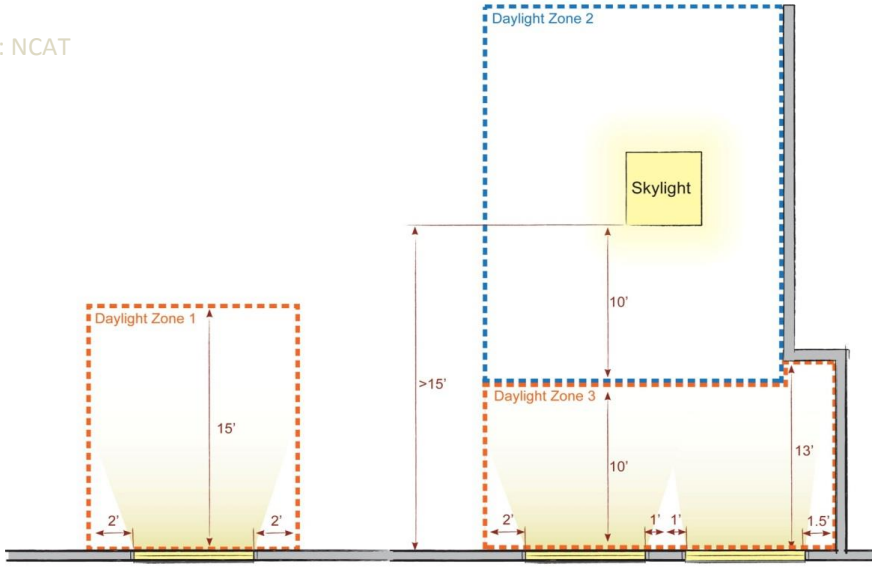


Specific Application Controls C405.2.3

Specific application controls must be provided for display and accent lighting including: lighting in display cases; supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting; lighting for nonvisual applications, such as plant growth and food warming; and lighting equipment that is for sale or for demonstrations in lighting education. Hotel and motel sleeping units and guest suites must have a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles.

Specific Application Controls C405.2.2.3.3

<u>These types to be controlled by dedicated, independent control:</u>

- Display and accent lighting
- Display case lighting
- Nonvisual applications (i.e., plant growth and food warming)
- Lighting equipment for sale or demonstration in lighting education

Hotel and motel sleeping units and guest suites must have a master control device at main room entry that controls all permanently installed luminaires and switched receptacles

Supplemental task lighting must have control devices integral to luminaires or must be controlled by readily accessible, wall-mounted control devices (This applies to permanently installed under-shelf or under-cabinet lighting)

Interior Lighting Power C405.5.2

The total connected interior lighting power in a building may be no greater than the total interior lighting power calculated using either the Building Area Method or the Space-by-Space Method. The Space-by-Space Method is new to the code. The values used to calculate the Building Area Method are unchanged. The Building Area Method involves multiplying the floor area for each building area type by the value for that area provided in table. For the Building Area Method, an "area" is defined as all contiguous spaces that accommodate or are associated with a single building area type. Each building area type is to be treated as a separate area. For the Space-by-Space Method, the interior lighting power allowance is determined by multiplying the floor area of each space times the value from the appropriate table for the space type that most closely represents the proposed use of the space, and then summing the lighting power allowances for all spaces. Tradeoffs among spaces in the final design are permitted.

Interior Lighting Power Density Calculation

Building Area Method **OR** Space-By-Space Method

The addition of the Space-by-Space Method is to provide design flexibility for demonstrating compliance. Either method may be used for additions, alterations, and renovations. The values for both the Building Area Method and the Space-by-Space Method are shown in the next two tables.

Interior Lighting Power Allowance: **Building Area Method**

	Basic Allowance	Add. Eff. Package
Building Area Type	**LPD (w/ft^2)**	**LPD (w/ft^2)**
Automotive facility	0.9	0.82
Convention center	1.2	1.08
Courthouse	1.2	1.05
Dining: bar lounge/leisure	1.3	0.99
Dining: cafeteria/fast food	1.4	0.90
Dining: family	1.6	0.89
Dormitory	1.0	0.61
Exercise center	1.0	0.88
Fire station	0.8	0.71
Gymnasium	1.1	1.00
Health care clinic	1.0	0.87
Hospital	1.2	0.88
Hotel	1.0	1.10
Library	1.3	1.18
Manufacturing facility	1.3	1.11
Motel	1.0	0.88
Motion picture theater	1.2	0.83
Multifamily	0.7	0.60
Museum	1.1	1.06
Office	0.9	0.90/0.85*
Parking garage	0.3	NA
Penetentiary	1.0	NA
Performing arts theater	1.6	1.39
Police station	1.0	0.96
Post office	1.1	0.87
Religious building	1.3	1.05
Retail	1.4	1.4/1.3*
School/university	1.2	0.99
Sports arena	1.1	0.78
Town hall	1.1	0.92
Transportation	1.0	0.77
Warehouse	0.6	0.60
Workshop	1.4	1.20

* - Use first value if daylight zone is ≥ 30% of conditioned floor area. Use second value for all other cases.

Interior Lighting Power Allowance: Space-by-Space LPD			
COMMON SPACE-BY-SPACE TYPES	**LPD (w/ft^2)**		**LPD (w/ft^2)**
Atrium – first 40 feet in height	0.03 per ft. ht.	Radiology/imaging	1.3
Atrium – above 40 feet in height	0.02 per ft. ht.	Operating room	2.2
Audience/seating area – permanent		Recovery	1.2
For auditorium	0.9	Lounge/recreation	0.8
For performing arts theater	2.6	Laundry – washing	0.6
For motion picture theater	1.2	Hotel	
Classroom/lecture/training	1.3	Dining area	1.3
Conference/meeting/multipurpose	1.2	Guest rooms	1.1
Corridor/transition	0.7	Hotel lobby	2.1
Dining area		Highway lodging dining	1.2
Bar/lounge/leisure dining	1.4	Highway lodging guest rooms	1.1
Family dining area	1.4	Library	
Dressing room perf. arts theater	1.1	Stacks	1.7
Electrical/mechanical	1.1	Card file and cataloguing	1.1
Food preparation	1.2	Reading Area	1.2
Laboratory for classrooms	1.3	Manufacturing	
Lab (medical/industrial/research)	1.8	Corridors/transition	0.4
Lobby	1.1	Detailed manufacturing	1.3
Lobby for performing arts theater	3.3	Equipment room	1
Lobby for motion picture theater	1	Extra high bay (> 50-foot floor-ceiling height)	1.1
Lobby for elevator	NA	High bay (25-– 50-foot floor-ceiling height)	1.2
Locker room	0.8	Low bay (< 25-foot floor-ceiling height)	1.2
Lounge recreation	0.8	Museum	
Office – enclosed	1.1	General exhibition	1
Office – open plan	1	Restoration	1.7
Restroom	1	Parking garage – garage areas	0.2
Sales area	1.6[a]	Convention center	
Stairway	0.7	Exhibit space	1.5
Storage	0.8	Audience/seating area	0.9
Workshop	1.6	Fire stations	
Courthouse/police station/penetentiary		Engine room	0.8
Courtroom	1.9	Sleeping quarters	0.3
Confinement cells	1.1	Post office	
Judge chambers	1.3	Sorting area	0.9
Penitentiary audience seating	0.5	Religious building	
Penitentiary classroom	1.3	Fellowship hall	0.6
Penitentiary dining	1.1	Audience seating	2.4
BUILDING SPECIFIC SPACE-BY-SPACE TYPES		Worship pulpit/choir	2.4
Automotive – service/repair	0.7	Retail	
Bank/office – banking activity area	1.5	Dressing/fitting area	0.9
Dormitory living quarters	1.1	Mall concourse	1.6
Gymnasium/fitness center		Sales area	1.6[a]
Fitness area	0.9	Sports arena	
Gymnasium audience/seating	0.4	Audience seating	0.4
Playing area	1.4	Court sports area – Class 4	0.7
Healthcare clinic/hospital		Court sports area – Class 3	1.2
Corridors/transition	1	Court sports area – Class 2	1.9
Exam/treatment	1.7	Court sports area – Class 1	3
Emergency	2.7	Ring sports area	2.7
Public and staff lounge	0.8	Transportation	
Medical supplies	1.4	Air/train/bus baggage area	1
Nursery	0.9	Airport concourse	0.6
Nurse station	1	Terminal – ticket counter	1.5
Physical therapy	0.9	Warehouse	
Patient room	0.7	Fine material storage	1.4
Pharmacy	1.2	Medium/bulky material	0.6

The merchandise lighting allowance footnotes have been moved from the Building Area Method table to the Space-by-Space Method table. There is now no additional merchandise lighting power allowance using the Building Area Method.

The total building lighting allowance may be increased if using the Space-by-Space Method where lighting equipment is installed to highlight specific merchandise in addition to general lighting and is switched or dimmed on different circuits. The smaller of the actual wattage of the lighting equipment installed for merchandise, or additional lighting power as determined using a formula based on the type of merchandise, may be added to the building allowance. The additional lighting power allowance is 500 watts plus the merchandise lighting allowance for the four types noted below:

Additional Merchandise Lighting Power Allowance

500 watts plus:

Area 1: All Other (0.6 W/SF)

Area 2: Vehicles, sporting goods, small electronics (0.6 W/SF)

Area 3: Furniture, clothing, cosmetics, artwork (1.4 W/SF)

Area 4: Jewelry, crystal, china (2.5 W/SF)

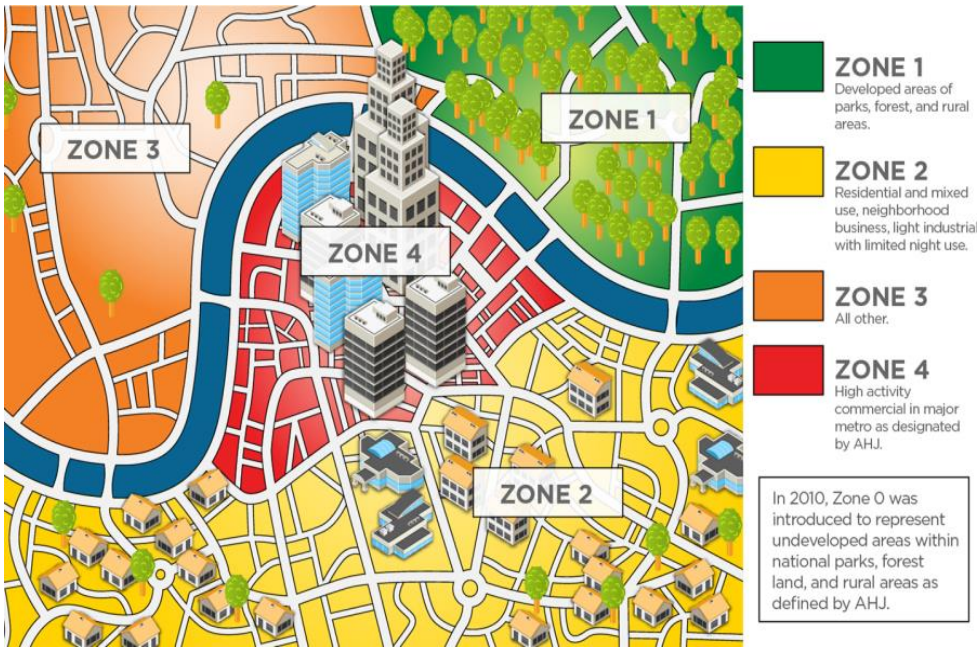
Exterior Building Lighting Power C405.6

The exterior building lighting power allowance includes a “base” allowance that varies by lighting zone, plus individual area and surface allowances. The four zones are illustrated in the graphic on the following page. Table C405.6.2 (1) in the code includes the lighting power allowances for exterior building areas but is not reproduced here due to space limitations.

Trade-offs are allowed only among surfaces listed as “Tradable” in the table. There are a number of exceptions for exterior applications equipped with an independent control device. Those exceptions are:

1. Transportation-related signal, directional, and marker lighting
2. Advertising or directional signage
3. Integral equipment or instrumentation lighting installed by the manufacturer
4. Theatrical lighting
5. Athletic playing areas
6. Temporary lighting
7. Industrial production, material handling, transportation sites, and associated storage areas
8. Theme elements in theme/amusement parks
9. Public monuments and registered historic landmark structures highlighting

A minimum efficacy provision for exterior lighting has been removed.

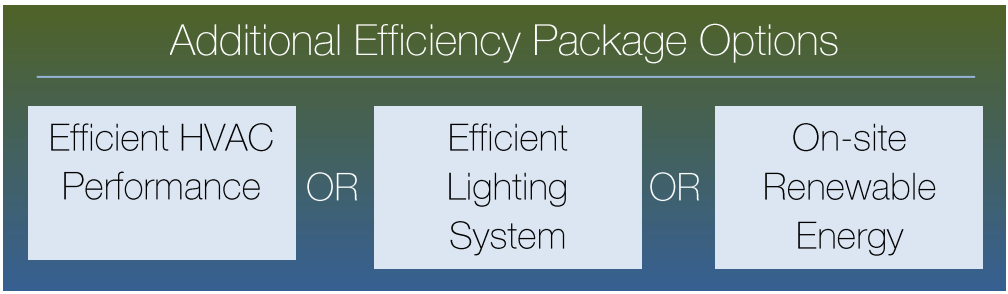


Note: In the above graphic "AHJ" stands for the Authority Having Jurisdiction.
Source: USDOE Building Energy Codes University

5. Additional Efficiency Package Options

This section is new to the IECC with the 2012 edition. If the prescriptive path is used to comply with the code, then at least one of three additional efficiency package options must be included in addition to all the other code requirements. These requirements are not applicable if the total building performance path is used for compliance.

The three options include a more efficient HVAC system, a more efficient lighting system, or on-site renewables.



Efficient HVAC Performance C406.2

To comply with efficient HVAC performance as an additional efficiency package, the building HVAC equipment must meet the performance requirements of a set of tables included in this section. This efficiency package may only be used where the equipment efficiencies of this provision are greater than the equipment efficiencies listed in standard minimum efficiency tables of Section C403. If equipment proposed for the building is not listed in this set of tables, then the HVAC performance efficiency package option is not available for the building.

Efficient Lighting System C406.3

The second additional efficiency package option is reduced lighting power density. With this option, the total allowable interior lighting power of the building may not exceed the calculated Lighting Power Density (LPD)

determined by using the values in the table provided for this section. The Building Area Method LPD table on page 36 includes the values to be used in qualifying the building for the Additional Efficiency Options Efficient Lighting System package.

On-Site Renewable Energy C406.4

The final additional efficiency package option is on-site renewable energy for which there are two compliance options. In one option the total minimum capacity ratings of on-site renewable energy systems must either provide at least 1.75 Btu/ft^2 or at least 0.50 watts/ft^2 of conditioned floor area. The second option is to provide at least 3% of the energy used within the building for building mechanical, service water-heating equipment, and lighting from on-site renewable energy.

6. System Commissioning

New Section C408 of the 2012 IECC details the requirements for mechanical and lighting system commissioning. The general code requirements for building mechanical systems are found in Section C403. The general code requirements for electrical and power systems are found in Section C405.

There are two exemptions from the mechanical commissioning requirements. In buildings where the total mechanical equipment capacity is less than 480,000 Btu/h cooling capacity and 600,000 Btu/h heating capacity, no commissioning is required. Simple HVAC systems that serve dwelling units and sleeping units in hotels, motels, and boarding houses are also exempt.

The commissioning process included in the code involves several steps. A commissioning plan is developed by the registered design professional and submitted with the construction documents to the code official. At the appropriate time, the system balancing and functional testing is performed by the entity identified in the commissioning plan. A preliminary commissioning report is submitted to the building owner who provides a letter to the code official accepting the report. The final mechanical inspection should be issued by

the code official only when this acceptance letter is received. The final commissioning report is to be delivered to the owner within 90 days of the receipt of the certificate of occupancy. The code recognizes that some final commissioning procedures may be deferred until after the final commissioning report is delivered to the owner due to climatic conditions.

Prior to passing the final mechanical inspection, the registered design professional must provide evidence of commissioning and completion. Construction document notes and specifications must clearly indicate provisions for commissioning requirements. Copies of all documents must be provided to the owner and made available to the code official upon request. The code official may require that copies of the preliminary and final commissioning reports be made available to the official.

The Commissioning Plan must include the following items:

- A narrative description of the activities that will be accomplished during each phase of commissioning, including the personnel intended to accomplish each of the activities
- A listing of the specific equipment, appliances, or systems to be tested and a description of the tests to be performed
- Functions to be tested, including, but not limited to, calibrations and economizer controls
- Conditions under which the test will be performed. At a minimum, testing shall affirm winter and summer design conditions and full outside air conditions.
- Measurable criteria for performance

The code stipulates that the Commissioning Plan must be developed by either a registered design professional (RDP) or an approved agency. In effect, the commissioning plan is to be done by the engineer of record, an outside engineer, or a third-party commissioning agent that is “approved” by the code official.

Design Phase

Commissioning Plan by Registered Design Professional (RDP):

- Narrative of activities to be performed with responsible personnel identified
- List equipment or systems and description of test
- Identify functions to be tested including calibration and economizer controls
- Identify required test conditions including winter and summer design conditions
- Identify measurable criteria for performance

Construction Phase

Systems Adjusting and Balancing (except fan motors ≤ 1 hp)

- Air & Water flow rates measured and systems must be balanced
- Air System Balancing
  - Supply air outlets and zone terminal devices equipped with means to balance
  - Discharge dampers prohibited on fan motors ≥ 10 hp
- Hydronic Systems Balancing (except pumps with motors ≤ 5 hp and where throttling results is < 5% of hp above if impeller trimmed)
  - Heating and cooling coils equipped with means for balancing
  - Capability to measure pressure across the pump

Post-Construction Phase

Functional Performance Testing

- Equipment - Testing must include all modes and sequences including part-load, full-load, and emergency, back-up, and alarms
- Controls - Test calibrated, adjusted, and operation in accordance with specification. Sequences must be functionally tested
- Economizers - Air economizers tested for function as designed

Design Phase

Note: Code official may require a copy of Preliminary Commissioning Report.

Construction Phase

Preliminary Commissioning Report

- Completed and certified by RDP or approved agency
- Provided to owner
- Itemization of deficiencies
- Note deferred tests
- Climatic conditions needed for deferred tests

Transmittal Letter: To code official from owner acknowledging receipt of preliminary commission report before final mechanical inspection approval

Post-Construction Phase

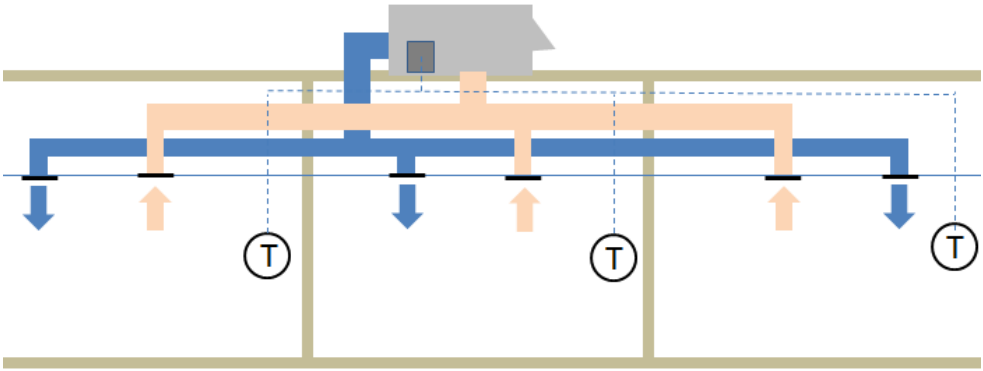
Final Documentation Requirements

- Drawings – Location and performance data on each piece of equipment
- O&M Manual – Equipment identification and size
  - Individual Equipment Manuals - Maintenance actions identified
  - Service Agency Identified – Include name and address
  - HVAC Controls System Maintenance and Calibration Information
  - System Operation Narrative – Including wiring diagrams, control sequences, and field determined set-points
- System Balancing Report
- Final Commissioning Report
  - Functional Testing Results
  - Deficiencies – Including corrective measures
  - Functional Testing Procedures

Submitted to Owner within 90 days of Certificate of Occupancy

The commissioning chapter concludes with requirements for functional testing of the lighting system. The testing is to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions. The project construction documents must state who will conduct the required functional testing. Where required by the code official, an approved party independent from the design or construction of the project will be responsible for the functional testing and provide documentation to the code official.

Where occupant sensors, time switches, programmable schedule controls, photosensors, or daylighting controls are installed, the functional testing is to confirm the placement, sensitivity and time-out adjustments for occupant sensors perform as specified; that the time switches and programmable schedule controls are programmed to turn the lights off; and that the placement and sensitivity adjustments for photosensor controls reduce electric light based on the amount of usable daylight in the space as specified.



Design Phase

Commissioning Plan by Registered Design Professional (RDP):

- Construction documents detail activities to be performed
- Construction documents state the party who will conduct testing
- Where required by the code official an approved independent party shall be responsible for the testing and documentation certifying the installed controls meet the provisions

Construction Phase

The following to be confirmed and tested:

- Conforms with construction documents
- Placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance
- Time switches and programmable schedule controls are programmed to turn the lights off
- Placement and sensitivity adjustments for photosensor controls reduce electric light based on the amount of usable daylight in the space as specified

Post-Construction Phase

The code does not define final documentation requirements for lighting. The character of the final lighting systems commissioning documentation is up to the code official.

Credits

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NCAT NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY

This document was prepared by the National Center for Appropriate Technology (NCAT). NCAT has been providing technical assistance for energy efficiency, renewable energy, and sustainable agriculture for over 35 years. NCAT, a non-profit organization, was created after the first energy crisis in 1973 to develop energy-saving strategies for homes and businesses. NCAT has offices in seven states and operates dozens of programs that promote clean energy and sustainable agriculture. Its headquarters is in Butte, Montana. More information about NCAT's programs and services is available at www.ncat.org.

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