2015 IECC Commercial Updates

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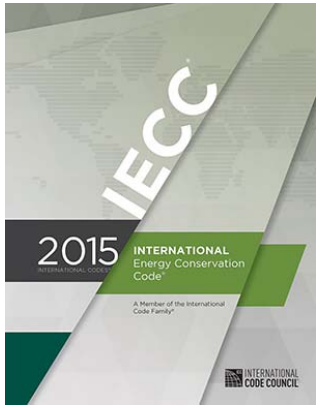


Funding for Energy Code Training

UTAH OFFICE OF ENERGY DEVELOPMENT

Utah Office of Energy Development
Building Talk Program

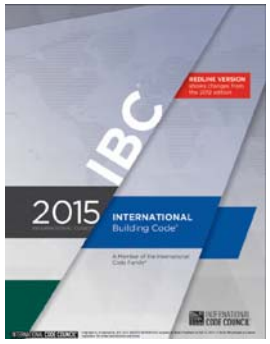
U.S. DEPARTMENT OF ENERGY

U.S. Department of Energy
energy codes.gov

QUESTAR Gas
ThermWise.com

ROCKY MOUNTAIN POWER
wattsmart New Homes Program

The 2015 codes contain many thousands of minor changes, correcting grammar, sentence structure, clarifications etc.



Structure of the 2015 IECC

Commercial Section	Residential Section
Ch. 1 Scope and Application / Administrative and Enforcement	Ch. 1 Scope and Application / Administrative and Enforcement
Ch. 2 Definitions	Ch. 2 Definitions
Ch. 3 General Requirements	Ch. 3 General Requirements
Ch. 4 Commercial Energy Efficiency	Ch. 4 Residential Energy Efficiency
Ch. 5 Existing Buildings - NEW	Ch. 5 Existing Buildings - NEW
Ch. 6 Referenced Standards	Ch. 6 Referenced Standards
Index	Index

Additions, alterations, existing buildings moved from Ch. 1. Includes several changes and new requirements

NEW 5

Single State Commercial IECC Amendment

C403.2.9.1.3 High-pressure duct systems. Ducts and plenums designed to operate at static pressures greater than 3 inches water gauge (747 Pa) shall be insulated and sealed in accordance with Section C403.2.8. In addition, ducts and plenums shall be leak tested in accordance with the SMACNA *HVAC Air Duct Leakage Test Manual* and shown to have a rate of air leakage (CL) less than or equal to 4.0 as determined in accordance with Equation 4-8.

$CL = F/P0.65$ **(Equation 4-8)**

where:

F = The measured leakage rate in cfm per 100 square feet of duct surface.

P = The static pressure of the test.

Documentation shall be furnished ~~by the designer~~ demonstrating that representative sections totaling at least 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

NEW

***Section C103* - Scope/Construction Documents**

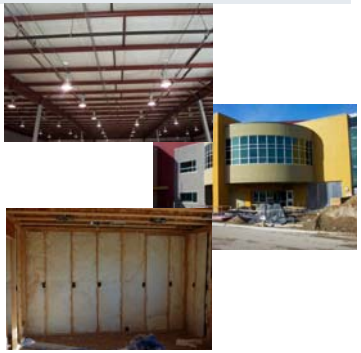
- ✓ Documentation shall be prepared by a registered design professional
- ✓ Electronic media can be used
- ✓ Information required:
  - ✓ Insulation materials and R-values
  - ✓ Fenestration U-factors, SHGC
  - ✓ Area-weighted U-factor and SHGC calculations
  - ✓ Mechanical system design criteria
  - ✓ Mechanical, SWH, equipment types, sizes, and efficiencies
  - ✓ Economizer description
  - ✓ Equipment and system controls
  - ✓ Duct sealing, duct and pipe insulation and location
  - ✓ Lighting fixture schedule with wattage and control narrative
  - ✓ Location of daylight zones
  - ✓ Air sealing details

The building thermal envelope shall be represented on the construction drawings.

7

Consistency is Critical in Energy Code Compliance

- U-Factors and R-values, all thermal performance values *must be identical* on:
  - *Plans*
  - *Specifications*
  - *Energy Compliance Documents*
  - *Design Calculations*



NEW

Inspections
Section C104

- Construction work for which a permit is required is subject to inspection by code official or designated agent
- Required inspections include:
  - Footing and foundation
  - Framing and rough-in
  - Plumbing rough-in
  - Mechanical rough-in
  - Electrical rough-in
  - Final

- Insulation and air barrier requirements may require inspection during the inspections above.
- Energy only inspections may be required

NEW

Low-energy Buildings
Section C402.1.1

Buildings or portions of buildings that are separated from remainder of building by building thermal envelope assemblies complying with C402 **are exempt** from the Envelope provisions if:

- Peak design rate of energy < 3.4 Btu/h/ft^2 or 1.0 watt/ft^2 of floor area for space conditioning purposes, **OR**
- Those portions or building that do not contain conditioned space, **OR**
- Greenhouses

NEW

Equipment Buildings
Section C402.1.2

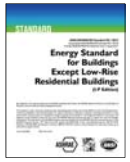
Buildings that comply with the following are exempt from the building thermal envelope provisions:

- Separate building with floor area < 500 ft^2 (50 m^2)
- Intended to house electronic equipment with installed equipment power totaling > 7 watts/ft^2 (75W/m^2)
- Heating system capacity < 17,000 Btu/hr (5 kW) and a heating thermostat set point that is restricted to < 50ºF
- Average wall and roof U-factor < 0.200 in Climate Zones 1-5 and < 0.120 in Climate Zones 6-8
- Comply with the roof solar reflectance and thermal emittance provisions for Climate Zone 1

NEW

Commercial Compliance Options

1 ASHRAE **90.1-2013**



OR

2 2015 IECC - Prescriptive

- C402 - Envelope
- C403 - Mechanical
- C404 - SWH
- C405 - Lighting

AND

- Pick One C406:
  - C406.2 – Eff. HVAC Performance
  - or
  - C406.3 – Reduced Lighting Power Density
  - or
  - C406.4 – Enhanced Lighting Controls
  - or
  - C406.5 – On-site Supply of Renewable energy
  - or
  - C406.6 – Dedicated Outdoor Air System or C406.7 – High Eff. Service Water Heating

OR

3 2015 IECC - Performance

- C407 – Total Building Performance
- C402.5 – Air Leakage
- C403.2 – Provisions applicable to all mechanical systems
- C404 - SWH
- Lighting Mandatory Sections
  - C405.2
  - C405.3
  - C405.4
  - C405.6
- Building energy cost to be ≤ 85% of standard reference design building

NEW

Additional Efficiency Package Options
Section C406

- One additional efficiency feature must be selected to comply with the IECC
  - More efficient HVAC performance, OR
  - Reduced lighting power density system, OR
  - **Enhanced lighting controls,** OR
  - On-site supply of renewable energy
  - **Dedicated outdoor air system, OR**
  - **More efficient SWH**

High Efficiency HVAC

More Efficient Lighting System

Onsite Renewables

Building Envelope Requirements

Section C402.1 - General

Building thermal envelope to comply with the following:

- Specific insulation requirements of Section C402.2
- Thermal requirements of either:
  - R-value-based method of Section C402.1.3
  - U-, C-, and F-factor-based method of Section C402.1.4 **OR**
  - Component performance alternative of Section C402.1.5
- Roof solar reflectance and thermal emittance
- Fenestration in building envelope assemblies
- Air Leakage of building envelope assemblies

Building Envelope Compliance Options

3 Methods for compliance of building components:

- C402.1.3 – Insulation component R-value based method
- C402.1.4 – Assembly U-factor, C-factor or F-factor based method
- C402.1.5 – Component Performance Alternative

NEW

Chapter 5 Prescriptive Approach Compliance

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, *R*-VALUE METHOD[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci	
Metal buildings[b,c]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	R-5.7ci[f]	R-5.7ci[f]	R-5.7ci[f]	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-19.5ci	R-13 + R-13ci	R-13+ R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13+ R-17.5ci
Wood framed and other	R-13 + R-5 ci or R-20	R-13 + R-5 ci or R-20	R-13 + R-5 ci or R-20	R-13 + R-7.5 ci or R-20	R-13 + R-7.5 ci or R-20	R-13 + R-7.5 ci or R-20	R-13 + R-7.5 ci or R-20	R-13 + R-7.5 ci or R-20	R-13 + R-7.5 ci or R-20	R-13 + R-7.5 ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5 ci or R-20 + R-3.8ci	R-13 + R-7.5 ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-10ci	R-13 + R-15.6ci or R-20 + R-10ci
Walls, below grade																
Below-grade wall[e]	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-10ci	R-10ci	R-12.5ci	
Floors																
Mass[e]	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30
Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs[f]	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 16" below	R-15 for 16" below	R-15 for 16" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque doors																
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.
ci = Continuous insulation, NR = No requirement, LS = Liner system.
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 C402.1.4.
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-ft² °F.
d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
e. "Mass floors" shall include floors weighing not less than:
1. 35 pounds per square foot of floor surface area; or
2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.
f. Steel floor joist systems shall be insulated to R-38.

Multiple Layers of Continuous Insulation

Section C402.2.1

Where > 2 layers of continuous insulation board are used in a construction assembly, the boards to be installed with Section C303.2.

Where manufacturer instructions do not address the installation, the edge joints between each layer should be staggered.

Roof Assembly
Section C402.2.2

Roof R-values and U-factor requirements are based on assembly type / insulation placement

- ✓Insulation entirely above deck
- ✓Metal buildings
- ✓Attic and other

Skylight curbs to be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less

Roof Solar Reflectance and Thermal Emittance
Section C402.3

High Albedo Roof - Example

Required in Climate Zones 1-3 for low-sloped roofs (less than 2 units vertical in 12 horizontal), directly above cooled conditioned spaces

Comply with one or more options:

1) Minimum three-year aged solar reflectance of 0.55 and minimum three-year aged thermal emittance of 0.75

OR

2) Three-year aged solar reflectance index of 64

Where aged solar reflectance required by Section C402.3 is not available, it should be determined with Equation 4-3

$$R_{aged} = [0.2+0.7(R_{initial} -0.2)]$$

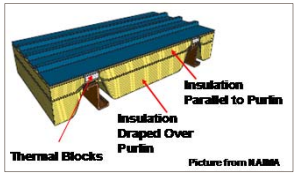
Roof Solar Reflectance and Thermal Emittance
Section C402.3 - Exceptions

- Portions of roofs that include or are covered by:
  - PV systems or components
  - Solar air or water heating systems or components
  - Roof gardens or landscaped roofs
  - Above-roof decks or walkways
  - Skylights
  - HVAC systems, components, and other opaque objects mounted above the roof
- Portions of roofs shaded during peak sun angle on June 21 by permanent features of the building or permanent features of adjacent buildings
- Ballasted roofs with minimum stone ballast of 17 lbs/ft^2 or 23 lbs/ft^2 pavers
- Roofs, where a minimum of 75% of the roof area meets one or more of the above exceptions

Roof R-Value
Insulation Completely Above Deck

- ✓Insulation considered continuous (*CI*)
- ✓Insulation thickness can vary ≤ 1” and area weighted U-factor meets the requirements of Table C402.1.3

Roof R-Value Metal Buildings



Thermal spacer block required on all metal buildings or must use U-factor Compliance Method

Two layers of insulation required

- ✓CZ 1-5 and marine 4: R-19+R-11 LS
- ✓CZ 6: R-25+R-11 LS
- ✓CZ 7-8: R-30+R-11 LS

Liner System includes the following:

- Continuous vapor barrier liner membrane that is installed below the purlins and that is uninterrupted by framing members
- An uncompressed, unfaced insulation resting on top of the liner membrane and located between purlins
- Multilayer installations, the last rated R-value of insulation is for unfaced insulation draped over purlins and compressed when the metal roof panes are attached

Wall R-Value

Wood, Metal Frame, and Other

Photo courtesy of Dow Building Solutions

- ✓Cavity insulation or cavity plus continuous (ci)
- ✓Continuous insulation not broken up by framing members e.g., rigid board insulation

Slab-on-Grade Floors

Section C402.2.5

- Unheated slab – insulation required:
  - ✓Climate Zones 4-8
- Heated slabs – insulation required in all Climate Zones
- **Exception**: where slab-on-grade floor is > 24" below finished exterior grade

NEW

Fenestration

Chapter 5 Prescriptive Approach

TABLE C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM *U*-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7						
Vertical fenestration													
U-factor													
Fixed fenestration	0.50		0.50		0.46		0.38		0.38		0.36		0.29
Operable fenestration	0.65		0.65		0.60		0.45		0.45		0.43		0.37
Entrance doors	1.10		0.83		0.77		0.77		0.77		0.77		0.77
SHGC													
Orientation[a]	SEW	N	SEW	N	SEW	N	SEW	N	SEW	N	SEW	N	SEW	N
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.40	0.53	0.40	0.53	0.40	0.53	0.45	NR
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.48	0.58	0.48	0.58	0.48	0.58	NR	NR
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.64	0.64	0.64	0.64	0.64	0.64	NR	NR
Skylights														
U-factor	0.75		0.65		0.55		0.50		0.50		0.50		0.50	
SHGC	0.35		0.35		0.35		0.40		0.40		0.40		NR	

NR = No requirement, PF = Projection factor.
a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.

Fenestration U-Factor
Section C402.4.3

Table C402.4 requirements by these categories:

- ✓ Fixed fenestration
- ✓ Operable fenestration
- ✓ Entrance doors

NEW

Vertical Fenestration Requirement
Section C402.4.1 – Prescriptive (Max area)

Percentage of Vertical Fenestration Area to Gross Wall Area

- ✓ Allowed up to 30% maximum of above grade wall
  - ✓ In Climate Zones 1-6, up to 40% maximum of above grade wall with daylighting controls

NEW

Skylight Minimum Fenestration Area
Section C402.4.1 Prescriptive

- ✓Limited to ≤ 3% of Roof Area
- ✓Up to 5% allowed if automatic daylighting controls installed in daylight zones under skylights

NEW

Increased Vertical Fenestration with Daylight Responsive Controls
Section C402.4.1.1

- ✓Up to 40% vertical fenestration area allowed in Climate Zones 1-6, provided
  - No less than 50% of the conditioned floor area is within a daylight zone in buildings < 2 stories above grade
  - No less than 25% of the net floor area is within a daylight zone in building ≥ 3 stories above grade
  - Daylight responsive controls complying with C405.2.3.1 are installed in daylight zones
  - VT of vertical fenestration is ≥ 1.1 times SHGC

Exception:

Fenestration that is outside the scope of NFRC 200 isn't required to comply with VT

NEW

Increased Skylight Area with Daylighting Controls

Section C402.4.1.2

- ✓Up to 5% of the roof area provided daylight responsive controls are installed in daylight zones under skylights per C405.2.3.1

Glazed Fenestration SHGC

What is Solar Heat Gain Coefficient?

- ✓"The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation."

Fenestration U-Factor

Section C303.1.3

How Do You Meet the Requirement?

- ✓ Fenestration product rating in accordance to NFRC 100
- ✓ Labeled and certified by the manufacturer
- ✓ Non-NFRC 100 rated fenestration
  - ✓ Default Glazed Fenestration U-factor Table C303.1.3(1)

Default U-Factors

Tables C303.1.3(1) (2) and (3)

Must use default values for product lacking NFRC Labels or other approved NFRC Certification

- Component Modeling Approach (CMA)
- Manufacturer's Data compiled per NFRC

Default values are significantly weaker than Prescriptive Tables.

TABLE C303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTORS

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

TABLE C303.1.3(2)
DEFAULT DOOR *U*-FACTORS

DOOR TYPE	*U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

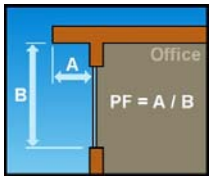
TABLE C303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

NEW

Fenestration SHGC Requirements

The Effect of Overhangs on Fenestration SHGC



- ✓ Overhangs allow a higher SHGC product to be installed
- ✓ Projection factor must be calculated
- ✓ When different windows or glass doors have different PFs
  - ✓ Evaluate separately

NEW

Increased Skylight SHGC and U-factor
Sections C402.4.3.1, C402.4.3.2

Skylights installed above daylight zones with daylight responsive controls:

- Climate Zones 1-6, permitted maximum SHGC 0.60
- Climate Zones 1-3, permitted maximum U-factor 0.90
- Climate Zones 4-8, permitted maximum U-factor 0.75

Doors
Section C402.4.4

Opaque doors having < 50% glass area
Comply with Tables C402.1.3 and C402.1.4

Swinging doors
- ✓ Meet U-factor requirement

Nonswinging
- ✓ R-4.75 in all climate zones

All other doors to comply with vertical fenestration requirements

NEW

Mandatory Requirements

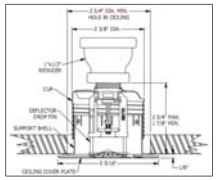
- ✓ Air Leakage
- ✓ Air barriers
- ✓ Fenestration air leakage
- ✓ Rooms Containing Fuel-burning Appliances
- ✓ Air intakes, exhaust openings, stairways and shafts
- ✓ Loading dock weatherseals
- ✓ Vestibules
- ✓ Recessed lighting

Air Barriers and Construction
Section C402.5.1.1

- Continuous air barrier required except in:
  - Climate Zone 2B
- Air barrier placement allowed:
  - Inside of building envelope
  - Outside of building envelope
  - Located within assemblies composing envelope **OR**
  - Any combination thereof
- Continuous for all assemblies part of the thermal envelope and across joints and assemblies
- Joints and seams sealed including sealing transitions in places and changes in materials, securely installed in or on the joint for its entire length to not dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation

Air Barriers and Construction
Section C402.5.1.1

- Penetrations of air barrier and air leakage paths to be caulked, gasketed or otherwise sealed in a manner compatible with construction materials and location
- Joints and seals
  - Sealed in same manner or taped or covered with moisture vapor-permeable wrapping material
- Sealing of concealed fire sprinklers where required in a manner recommended by manufacturer
  - Caulking or other adhesive sealants should not be used to fill voids between fire sprinkler cover plates and walls, or ceilings
- Recessed lighting to comply with C402.5.7
- Where similar objects are installed that penetrate the air barrier, make provisions to maintain the air barrier's integrity



Air Barrier Materials (Compliance)
Section C402.5.1.2.1

Materials with air permeance ≤ 0.004 cfm/ft² under pressure differential of 0.3 in. w.g. tested in accordance with ASTM E 2178

These materials meet this requirement:

Material	Thickness (minimum)
Plywood	3/8 in.
Oriented strand board	3/8 in.
Extruded polystyrene insulation board	½ in.
Foil-faced urethane insulation board	½ in.
Closed cell spray foam minimum density of 1.5 pcf	1-1/2 in.
Open cell spray foam density between 0.4 and 1.5 pcf	4.5 in.
Exterior gypsum sheathing or interior gypsum board	½ in.
Cement board	½ in.
Built up roofing membrane	
Modified bituminous roof membrane	
Fully adhered single-ply roof membrane	
A Portland cement/sand parge, stucco, or gypsum plaster	5/8 in.
Cast-in-place and precast concrete	
Sheet metal or aluminum	
Solid or hollow masonry constructed of clay or shale masonry units	

Air Barrier Assemblies (Compliance)
Section C402.5.1.2.2

OR

Assemblies of materials and components (sealants, tapes, etc.) with average air leakage ≤ 0.04 cfm/ft² under pressure differential of 0.3 in. w.g. tested in accordance with ASTM E 2357, 1677 or 283

The following assemblies are deemed to comply provided that joints are sealed and Section C402.5.1.1 (Air Barrier Construction) is met:

- Concrete masonry walls coated with either one application either of block filler or two applications of a paint or sealer coating OR
- Masonry walls constructed of clay or shale masonry units with a nominal width of ≥ 4" OR
- Portland cement/sand parge, stucco or plaster > ½" thick

NEW

Rooms Containing Fuel-burning Appliances

Section C402.5.3

- Appliances and combustion air openings to be located outside the building thermal envelope or enclosed in a room isolated from inside the thermal envelope in Climate Zones 3-8
- Where open combustion air ducts provide combustion air to open combustion *space conditioning* fuel-burning appliances
- Rooms to be sealed and insulated per envelope requirements
- Doors into the rooms fully gasketed
- Water lines and ducts insulated
- Combustion air ducts that pass through conditioned space, insulated to ≥ R-8

NEW

Rooms Containing Fuel-burning Appliances

Section C402.5.3 – Cont'd.

Exceptions:

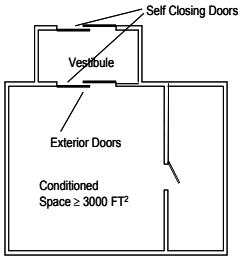
- Direct vent appliances with both intake and exhaust pipes installed continuous to the outside
- Fireplaces and stoves complying with 901-905 IMC and Section 2111.13 IBC

NEW

Vestibules

Section C402.5.7

- ✓ Required to reduce infiltration into spaces
- ✓ Required on entrance doors leading into spaces ≥ 3,000 ft^2
- ✓ Doors must have self-closing devices
- ✓ **Exceptions:**
  - Buildings in Climate Zones 1 and 2
  - Doors not intended for use by the public
  - Doors from a sleeping unit or dwelling unit
  - Revolving doors
  - Doors that have an air curtain with velocity > 6.56 ft/second at the floor tested in accordance with ANSI/AMCA 220 installed in accordance with manufacturer's instructions. Manual or automatic controls provided that will operate the air curtain with opening and closing. Air curtain and their controls to comply with Section C408.2.3.



NEW

Existing Buildings Chapter 5 -- NEW

Section C501 - General

- ✓ Additions, alterations, or repairs
- ✓ Existing buildings
- ✓ Maintenance
- ✓ Compliance
- ✓ New and replacement materials
- ✓ Buildings designated as historic

Existing Buildings
Section C502 - Additions

Any nonconditioned space that is altered to become conditioned space shall be required to be brought into full compliance with this code

Examples:

- ✓Converting part of an unconditioned warehouse to office space
- ✓Shell building tenant build-out

Alterations
Section C503.2 – Change in Occupancy

- ✓Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code
- ✓Where the use in a space changes from one to another in Tables C405.4.2(1) or C405.4.2(2), the installed lighting wattage shall comply with Section 405

Existing Buildings
Section R503 - Alterations

Exceptions:

- ✓Storm windows over existing fenestration
- ✓Surface-applied window film installed on existing single pane
- ✓Exposed, existing ceiling, wall or floor cavities if already filled with insulation
- ✓Where existing roof, wall or floor cavity isn't exposed
- ✓Roof recover
- ✓Reroofing for roofs where neither sheathing nor insulation exposed
  - Insulate above or below the sheathing
    - Roofs without insulation in the cavity
    - Sheathing or insulation is exposed
- ✓ Lighting alterations if:
  - <50% of luminaries in a space are replaced
  - Only bulbs and ballasts within existing luminaries are replaced (provided installed interior lighting power isn't increased)

NEW

Existing Buildings
Section C503 - Alterations

- Heating and Cooling
  - New HVAC systems and duct systems that are part of the alteration to comply with Section C403
    - Economizers – new cooling systems that are part of the alteration to comply with Section C403.3
- Service hot water systems
  - New SWH systems that are part of the alteration to comply with C404
- Lighting Systems
  - New Lighting systems that are part of the alteration to comply with C404
    - **Exception** – alteration that replace <10% of the luminaires in a space provided such alteration does not increase the installed interior lighting power

NEW

Building Mechanical Systems

- Heating
- Cooling
- Ventilation
- Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and freezers




Does My Project Need to Comply with the IECC?

All Buildings Other Than:

- ✓One- and two-family residential
- ✓R-2, R-3, R-4 three stories or less in height


NEW

Additional Efficiency Package Options
Section C406

- One additional efficiency feature must be selected to comply with the IECC
  - More efficient HVAC performance, OR
  - Reduced lighting power density system, OR
  - **Enhanced lighting controls,** OR
  - On-site supply of renewable energy
  - **Dedicated outdoor air system, OR**
  - **More efficient SWH**


High Efficiency HVAC


More Efficient Lighting System


Onsite Renewables

NEW

Additional Efficiency Package Options
Section C406

- Efficient HVAC performance per C406.2
  - Per Tables C403.2.3(1) thru C403.2.3(7)
  - Only used when efficiencies in the above tables are greater than 10% in addition to the requirements in C403
  - Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10%
  - Variable refrigerant flow systems exceed energy efficiency provisions of 90.1-2013 by 10%
  - Equipment not listed in tables above shall be limited to 10% of total building system capacity
- Reduced lighting power per C406.3
  - Whole building LPD determined using 90% of values in Table C405.4.2(1) x floor area for the building types OR
  - Using 90% by the space-by-space method in Section C405.4.2
  - Determine total LPD of building using reduced whole building interior lighting power in Table 406.3 x floor area for the building types

NEW

Additional Efficiency Package Options

Section C406 – Cont'd.

- Enhanced digital lighting controls per C406.4, controls located and operated in accordance with C405.2.2:
  - Luminaires capable of continuous dimming
  - Luminaires capable of being addressed individually OR a controlled group of ≤ 4 luminaires
  - ≤ 8 luminaires controlled together in a daylight zone
  - Fixtures controlled through digital control system that includes the following function:
    - Control reconfiguration based on digital addressability
    - Load shedding
    - Individual user control of overhead general illumination in open offices
    - Occupancy sensors capable of being reconfigured through the digital control system
  - Construction documents including submittal of Sequence of Operations including specs outlining each function of the fixture requirements above
  - Functional testing of controls comply with C408

NEW

Additional Efficiency Package Options

Section C406 – Cont'd.

- On-site renewable energy per C406.5
  - Total minimum ratings to
    - Provide ≥ 1.75 Btu or ≥ 0.50 watts per ft^2 of conditioned floor area OR
    - Provide ≥ 3% of energy used for mechanical and SWH equipment and lighting
- Dedicated outdoor air system per C406.6
  - Be equipped with an independent ventilation system designed to provide ≤100% outdoor air to each occupied space
  - Ventilation system capable of total energy recovery
  - HVAC system include supply-air temperature controls that automatically reset the supply-air temp. in response to building loads or outdoor air temperatures
  - Controls reset the supply-air temp. at least 25% of the difference between design supply-air temp. and design room-air temp.

NEW

Additional Efficiency Package Options

Section C406 – Cont'd.

- Reduced energy use in SWH per C406.7

  Buildings with the following types allowed to use this compliance method:
  - Group R-1: Boarding houses, hotels, or motels
  - Group I-2: Hospitals, psychiatric hospitals, and nursing homes
  - Group A-2: Restaurants and banquet halls or buildings containing food preparation areas
  - Group F: Laundries
  - Group R-2: Buildings with residential occupancies
  - Group A-3: Health clubs and spas
  - Buildings showing a service hot water load of ≥10% of total building energy loads as shown with an energy analysis per C407

NEW

Additional Efficiency Package Options

Section C406 – Cont'd.

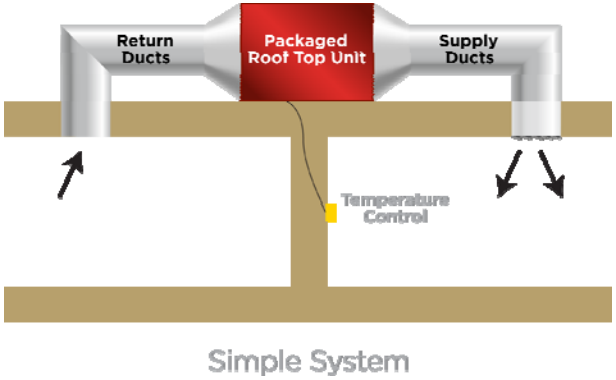
- Reduced energy use in SWH (cont'd)

Load fraction:

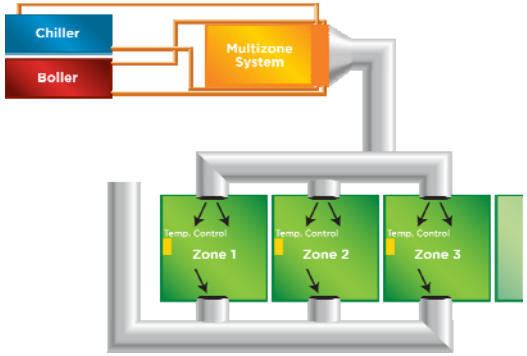
Building SWH system has ≥1 of the following sized to provide > 60% of hot water requirements or sized to provide 100% of hot water requirements if building complies with C403.4.7

- Waste heat recovery from service hot water, heat recover chillers, building equipment, process, equipment, or combined heat and power system
- Solar water-heating systems

Simple Systems



Complex Systems



NEW

Mandatory Provisions - *Section C403.2*

Provisions Applicable to ALL Mechanical Systems

- ✓ HVAC Load Calculations
- ✓ Equipment and System Sizing
- ✓ HVAC Equipment Performance Requirements
- ✓ HVAC System Controls
- ✓ Hot Water Boiler Outdoor Temp. Set-back Control
- ✓ Ventilation
- ✓ Energy Recovery Ventilation Systems
- ✓ Kitchen Exhaust Systems
- ✓ Duct and Plenum Insulation and Sealing
- ✓ Piping Insulation
- ✓ HVAC System Commissioning and Completion
- ✓ Air System Design and Control
- ✓ Heating Outside a Building
- ✓ Refrigeration Equipment Performance
- ✓ Walk-in Coolers and Freezers, Refrigerated Warehouse Coolers and Freezers
- ✓ Walk-in Coolers and Walk-in Freezers

HVAC Load Calculations

Section C403.2.1 Mandatory

Heating and cooling load sizing calculations required

- ✓ ASHRAE/ACCA Standard 183 OR
- ✓ Other approved computation procedures – defined in Chapter 3
  - Interior design conditions
    - Specified by Section C302 of the IECC
      - ≤ 72ºF for heating load
      - ≥ 75ºF for cooling load
- ✓ Loads reduced from energy recovery systems utilized in the HVAC system shall be accounted for in accordance with the ASHRAE HVAC Systems and Equipment Handbook

NEW

Table C403.2.3(2)
Mandatory

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE
				Before 1/1/2016	As of 1/1/2016	
Air cooled (cooling mode)	< 65,000 Btu/h	All	Split system	13.0 SEER	14.0 SEER	AHRI 210/240
			Single packaged	13.0 SEER	14.0 SEER	
Through-the-wall air cooled	≤ 30,000 Btu/h	All	Split system	12.0 SEER	12.0 SEER	
			Single packaged	12.0 SEER	12.0 SEER	
Single-duct high-velocity air cooled	< 65,000 Btu/h	All	Split system	11.0 SEER	11.0 SEER	

System Controls
Section C403.2.4 (Mandatory)

Control required for each system
- ✓if zoned for each zone

System Controls (Mandatory)
Section C403.2.4.1.1 Heat Pump Supplementary Heat

Heat pump systems
- ✓Heat pump thermostat required when supplying electric resistance heating
- ✓Control must prevent supplemental heat demand when heat pump can meet the heating load.
  - Except during defrost

Controls (Mandatory)
Section C403.2.4.1.2 Deadband

Thermostats must have at least a 5°F deadband
- ✓**Exception**:
  - Thermostats requiring manual change over between heating and cooling
  - Occupancies or applications requiring precision in indoor temperature control as approved by code official

Controls (Mandatory)
Section C403.2.4.2 Off Hour

Automatic time clock or programmable system
- ✓ **Exceptions:**
  - Zones operated continually
  - Zones with full HVAC load demand <6,800 Btu/h and has a readily accessible shut off switch

Thermostatic setback capabilities
- ✓ Capability to maintain zone temps down to 55ºF or up to 85ºF

Automatic setback and shutdown
- ✓ Seven different daily schedules/week
- ✓ Retain programming ≥ 10 hrs with loss of power **AND**
  - ✓ Manual override up to 2 hours **OR**
  - ✓ Manual timer capable of operating up to 2 hours **OR**
  - ✓ Occupancy sensor

Demand Controlled Ventilation *Section C403.2.6.1 (Mandatory)*

DCV must be provided for each zone with spaces > 500 ft² and the average occupant load ≥ 25 people/1000 ft² of floor area where the HVAC system has:
- ✓ An air-side economizer, **or**
- ✓ Automatic modulating control of the outdoor air damper, **or**
- ✓ A design outdoor airflow > 3,000 cfm

Demand control ventilation (DCV): a ventilation system capability that 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 design occupancy.

NEW

Enclosed Parking Garage Ventilation Controls
Section C403.2.6.2 (Mandatory)

- Garages for storing or handling automobiles operating under their own power shall employ contamination-sensing devices and automatic controls configured to stage fans or modulate fan average airflow rates to ≤ 50% of design capacity, or intermittently operate fans < 20% of occupied time or as required to maintain acceptable contaminant levels in accordance with IMC provisions
- Failure of these devices shall cause the exhaust fans to operate continuously at design airflow

Exceptions:
- Garages with total exhaust capacity < 22,500 cfm with ventilation systems that do not utilize heating or mechanical cooling
- Garages that have garage area to ventilation system motor nameplate power ratio >1,125 cfm/hp and do not utilize heating or mechanical cooling

NEW

Energy Recovery Ventilation Systems
Section C403.2.7 (Mandatory)

- ✓ Applies to fan systems with supply airflow rates > values in Tables C403.2.7(1-2)
- ✓ Exhaust air total recovery efficiency must be ≥ 50%
- ✓ When an air economizer is required
  - include a bypass or controls that permit operation of economizer per C403.3

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.

NEW

Energy Recovery Ventilation Systems

Section C403.2.6 (Mandatory)

Exceptions:

- Where energy recovery ventilation systems prohibited by the IMC
- Lab fume hood system with at least one of the following:
  - VAV hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to ≤ 50% of design values
  - Direct makeup (auxiliary) air supply equal to at least 75% of exhaust rate, heated no warmer than 2ºF below room setpoint, cooled to no cooler than 3ºF above room setpoint, no humidification added, and no simultaneous heating and cooling use for dehumidification control
- Systems serving uncooled spaces and heated to < 60ºF
- Where > 60% of outdoor heating energy is from site-recovered or site solar energy
- Heating energy recovery in Climate Zones 1-2
- Cooling energy recovery in Climate Zones 3C, 4C, 5B, 5C, 6B, 7, and 8
- Systems requiring dehumidification that employ energy recovery in series with the cooling coil
- Where largest source of air exhausted at a single location at building exterior is < 75% of design outside air flow rate
- Systems expected to operate < 20 hours/week at outdoor air % covered by Table C403.2.7(1)
- Systems exhausting toxic, flammable, paint or corrosive fumes or dust
- Commercial kitchen hoods used for collecting and removing grease vapors and smoke

Piping Insulation

Section C403.2.10 (Mandatory)

All piping serving heating or cooling system must be insulated in accordance with Table C403.2.10

Minimum Pipe Insulation
(thickness in inches)

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu · in./(h · ft² · °F)ª	Mean Rating Temperature, °F	< 1	1 to < 1½	1½ to < 4	4 to < 8	≥ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0

(Partial table)

Allowable Fan Motor Horsepower

Section C403.2.12.1 (Mandatory)

BHP option includes adjustment “adders” and “deducts” for certain devices

Single-zone variable air volume systems shall comply with the constant volume fan power limitation

Table C403.1.12.1(2)
Fan Power Limitation Pressure Drop Adjustment

DEVICE	ADJUSTMENT
Credits	
Fully ducted return and/or exhaust air systems	0.5 in w.c. (2.15 in w.c. for laboratory and vivarium systems)
Return and/or exhaust air flow control devices	0.5 in w.c.
Exhaust filters, scrubbers, or other exhaust treatment.	The pressure drop of device calculated at fan system design condition.
Particulate Filtration Credit: MERV 9 thru 12	0.5 in w.c.
Particulate Filtration Credit: MERV 13 thru 15	0.9 in w.c.
Particulate Filtration Credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2x clean filter pressure drop at fan system design condition.
Carbon and Other gas-phase air cleaners	Clean filter pressure drop at fan system design condition.

(Partial table)

Heating Outside a Building

Section C403.2.13 (Mandatory)

Systems are to be radiant systems

Controlled by an occupancy sensing device or timer switch

- So system is automatically deenergized when no occupants are present

NEW

Refrigeration Equipment Performance
Section C403.2.14

- Equipment have an energy use in kWh/day ≤ the values of Tables C403.2.14(1-2) when tested and rated in accordance with AHRI Standard 1200
- Energy use shall be verified through certification under an approved certification program or where a certification program does not exist, the energy use shall be supported by data furnished by the equipment manufacturer

NEW

Walk-in Coolers, Walk-in Freezers, Refrigerated Warehouse Coolers/Freezers
Section C403.2.15

- Be equipped with automatic door-closers that firmly close walk-in doors that have been closed to within 1" of full closure
  - **Exception** – automatic closers are not required for doors >45" in width or > 7ft in height
- Doorways have strip doors, curtain, spring hinged doors or other approved method of minimizing infiltration when doors are open
- Walk-in coolers and refrigerated warehouse coolers shall have wall, ceiling, and door insulation of ≥ R-25 and walk-in freezers and refrigerated warehouse freezers ≥ R-32
  - **Exception** – glazed portions of doors or structural members need not be insulated

NEW

Economizers
Section C403.3

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B	No requirement
2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	Economizers on individual DX cooling units ≥ 54,000 Btu/h[a]
	Economizer (usually central water economizer) on any chilled water cooling unit if total cooling meets table C403.3 limits (60 tons+)

NEW

Fan Airflow Control
Section C403.4.1.1

Each cooling system listed in Table C403.4.1.1 be designed to vary the indoor fan airflow as a function of load and comply with the following:

- Direct expansion (DX) and chilled water cooling units that control capacity of mechanical cooling directly based on space temp to have not fewer than 2 stages of fan control
  - Low or minimum speed ≤ 66% full speed
    - fan to draw ≤ 40% of fan power at full fan speed
    - Used during period of low cooling load and ventilation-only operation
- Other units including DX cooling and chilled water that control the space temp. by modulating the airflow to the space have modulation fan control (usually a variable speed drive)
  - Minimum speed ≤ 50% of full speed
    - Fan to draw ≤ 30% of fan power at full fan speed
  - Low or minimum speed used during period of low cooling load and ventilation-only operation

NEW

Hydronic System Controls

Section C403.4.2

- ✓Limit reheat/recool of fluids
- ✓Multiple boiler heating plants must include automatic controls capable of sequencing operation of the boilers
- ✓Single boilers > 500,000 Btu/h input design capacity must include multi-staged or modulating burner

NEW

Heat Rejection Equipment

Section C403.4.3

Each tower fan powered by a motor ≥ 7.5 hp must include variable speed or two speed fan

- ✓Have controls to automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device
- ✓**Exception**:
  - Factory-installed heat rejection devices within condensers and chillers tested and rated in accordance with Tables C403.2.3(6) and C403.2.3(7)

NEW

Requirements for Complex Systems Serving Multiple Zones

Section C403.4.4

- ✓Must be variable air volume (VAV) systems
- ✓VAV systems must be designed and capable of being controlled to reduce the primary air supply to each zone before reheat, recool, or mixing take place
- ✓Maximum airflow in reheat, recool, or mixing—one of:
  - 30% of the maximum supply air to each zone
  - ≤ 300 cfm where the maximum flow rate is <10% of total fan system design supply airflow rate
  - Minimum ventilation requirements from Chapter 4 of the IMC
  - Any higher rate that can be demonstrated to reduce overall system annual energy use by off setting reheat/recool energy losses through reduction in outdoor air intake for the system, as approved by code official
  - Airflow rate required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates

NEW

Exceptions

Section C403.4.4

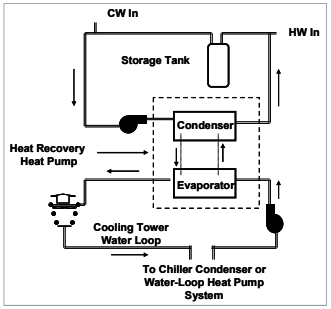
Exceptions from VAV control (individual zones or systems):

- ✓Where ≥ 75% of reheat energy comes from site-recovered or site-solar energy source
- ✓Zones with special humidity requirements
- ✓Zones with ≤ 300 cfm peak supply and flow rate is < 10% of total fan system supply airflow rate
- ✓Zones where reheated, recooled or mixed air volume < minimum ventilation requirements (Chapter 4 of IMC)
- ✓Systems with controls capable of preventing reheating, recooling, mixing or simultaneous supply of air previously heated or cooled

NEW

Heat Recovery for Service Hot Water Heating

Section C403.4.5



Condenser heat recovery required for heating/reheating of SWH provided:

- ✓ Facility operates 24 hours/day
- ✓ Total installed heat capacity of the heat rejection of water-cooled systems >6,000,000 Btu/hr
- ✓ Design SWH load >1,000,000 Btu/hr

Capacity to provide the smaller of

- ✓ 60% of peak heat rejection load at design conditions OR
- ✓ Preheating to raise peak SWH to 85ºF

Exceptions:

- ✓ Recovered heat is used for space heating or when SWH is provided by renewables or site recovered energy sources

NEW

Service Water Heating

Section C404

Table C404.2 Minimum Performance of Water-Heating Equipment

- ✓ Water Heater Types Covered
  - Electric Storage
  - Gas and Oil Storage
  - Instantaneous Water Heaters – Gas and Oil
  - Hot water boilers – gas and oil
  - Pool heaters
  - Unfired storage tanks

Heat Traps *(C404.3)*
Piping Insulation *(C404.4)*
Efficient Piping*(C404.5)*
Circulation & Temperature Maintenance *(C404.6)*
Demand Recirculation *(C404.7)*
Drain Heat Recovery*(C404.8)*
Pools and Spas *(C404.9)*
Portable Spas *(C404.10)*
SWH Commissioning*(C404.11)*

NEW

Energy Consumption of Pools and Permanent Spas

Section C404.9 Mandatory

Heaters *(C404.9.1)*

- ✓ Readily accessible on-off switch, that is an integral part of heater, mounted on the exterior of heater or external to within 3 feet of heater
- ✓ Switch should not change the setting of the heater thermostat
- ✓ Switches to be in addition to a circuit breaker for the power to the heater
- ✓ Natural gas or LPG fired pool heaters will not have continuously burning pilot lights

Time switches or other control method *(C404.9.2)*

- ✓ Automatic controls required to control heaters and pumps on a preset schedule
- ✓ **Exceptions**:
  - Where public health standards require 24 hour operation
  - Where pumps are required to operate solar and waste heat recovery pool heating systems

Note: heaters, pumps and motors with built-in timers meet this requirement

NEW

Mechanical Systems and SWH Commissioning and Completion

Section C408.2

- ✓ Prior to passing final mechanical and plumbing inspection
  - Registered design profession to provide evidence of commissioning and completion
- ✓ Construction document notes to clearly indicate provisions for commissioning and completion requirements
  - Permitted to refer to specifications
- ✓ Copies of all documents to be provided to the owner and made available to code official upon request

Mechanical Systems Commissioning and Completion Requirements
Section C408.2 Exceptions

- ✓These systems are exempt from commissioning requirements
  - In buildings where total mechanical equipment capacity is < 480,000 Btu/h (40 tons) cooling capacity **and** < 600,000 Btu/h combined service water heating and space-heating capacity
  - Included in Section C403.3 that serve individual dwelling units and sleeping units

Documentation Requirements
Section C408.2.5

- ✓Construction documents to specify that documents described in C408.2.5 be provided to building owner or owner's authorized agent within 90 days of receipt of certificate of occupancy
  - ✓Drawings
  - ✓Manuals
  - ✓System balancing report
  - ✓Final commissioning report
- ✓Drawings
  - ✓Include location and performance data on each piece of equipment

NEW

Electrical Power and Lighting Systems

When do the Lighting and Power Requirements Apply?

- ✓Original Installed Lighting System in a New Building, Addition, or Tenant Build-out
- ✓Existing Lighting System that is Altered
- ✓Change in Occupancy that Increases Energy
- ✓Change in Occupancy that requires less LPD as shown in the LPD tables

Exceptions:

- Historic buildings
  - State or National listing
  - Eligible to be listed
- Alterations where less than 10% of the luminaires in a space are replaced and installed interior power lighting is not increased
- Lighting within dwelling units
  - Where ≥ 75% of permanently installed fixtures (except low-voltage) are fitted for and include high-efficacy lamps
- Walk-in coolers, walk-in freezers, refrigerated warehouse coolers, and refrigerated warehouse freezers comply with C403.2.15 or C403.2.16

NEW

What's Covered Under Electrical Power and Lighting Systems Requirements?

- Mandatory Interior Lighting requirements
  - Required Controls
  - Wattage/Efficiency Limits
- Interior Lighting Power Allowances (watts/ft^2)
- Exterior Lighting Controls
  - Required Controls
  - Lamp Efficiency
- Exterior Lighting Power Allowances (watts/ft^2)
- Electric Metering
- Electrical Transformers and Motors
- Vertical and Horizontal Transportation Systems and Equipment

What's Covered Under Electrical Power and Lighting Systems Requirements?

Exception:

- Dwelling units within commercial building are not required to comply IF they comply with the residential Section R404.1

A minimum of 75 percent of the lamps in permanently installed lighting fixtures are high-efficacy lamps or 75% of permanently installed lighting fixtures contain only high efficacy lamps

Exception:

✓ Low-voltage lighting

High-Efficacy Lamps - Definition

✓ Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy based on lamp wattage

Lamp Wattage	Efficacy
> 40 watts	60 lumens/watt
15-40 watts	50 lumens/watt
< 15 watts	40 lumens/watt

Interior Lighting Power Allowance
Section C405.4.2

Two methods to determine allowance:

✓ Building Area Method
- Floor area for each building area type x value for the area
- "area" defined as all contiguous spaces that accommodate or are associated with a single building area type as per the table
- When used for an entire building, each building area type to be treated as a separate area

✓ Space-by-Space Method
- Floor area of each space x value for the area
- Then sum the allowances for all the spaces
- Tradeoffs among spaces are allowed

Building Area Method
Table C405.4.2(1)

Building Area Type	LPD (w/ft²)
Automotive facility	0.8
Convention center	1.01
Courthouse	1.01
Dining: bar lounge/leisure	1.01
Dining: cafeteria/fast food	0.9
Dining: family	0.95
Dormitory	0.57
Exercise center	0.84
Fire station	0.67
Gymnasium	0.94

(partial table)

Space-By-Space Method
Table C405.4.2(2)

Common Space-by-Space Types	LPD (w/ft²)
Atrium – First 40 feet in height	0.03 per foot in total height
Atrium – Above 40 feet in height	0.40+0.02 per foot in total height
Audience/seating area – permanent	
In an auditorium	0.63
In a convention center	0.82
In a gymnasium	0.65
In a motion picture theater	1.14
In a penitentiary	0.28
In a performing arts theater	2.43
Classroom/lecture hall/training room	
In a penitentiary	1.34
Otherwise	1.24

(partial table)

NEW

Lighting Controls
Section C405.2 - Mandatory

Lighting systems required to be provided with controls as specified for:

- Occupant sensor controls – C405.2.1
- Time-switch controls – C405.2.2
- Daylight-responsive controls – C405.2.3
- Specific application controls – C405.2.4
- Exterior lighting controls – C405.2.5

Exemptions:

- Security or emergency areas that must be continuously lighted
- Interior exit stairways, interior exit ramps and exit passageways
- Emergency egress lighting normally off

NEW

Occupant Sensor Controls
Sections C405.2.1, C405.2.1.1

Occupancy sensors are required in:

- ✓ Classrooms/lecture/training rooms
- ✓ Conference/meeting/multipurpose rooms
- ✓ Lounges
- ✓ Employee lunch and break rooms
- ✓ Private offices
- ✓ Restrooms
- ✓ Storage rooms
- ✓ Janitorial closets
- ✓ Locker rooms
- ✓ Other spaces < 300 ft² enclosed by floor-to-ceiling height partitions
- ✓ Warehouses

Occupancy sensor function (other than for warehouses):

- ✓ Automatically turn lights off within 30 minutes of occupants leaving space
- ✓ Either manual-on or controlled to automatically turn lighting on to not more than 50% power
- ✓ Incorporate a manual control to allow occupants to turn off the lights

Manual Controls
Section C405.2.2.3

Manual controls comply with the following:

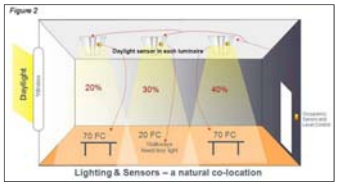
- ✓ Readily accessible to occupants
- ✓ Located where the controlled lights are visible OR
- ✓ Must identify the area served by the lights and indicate their use

NEW

Daylight-responsive Controls

Section C405.2.3

- Definition: A device or system that provides automatic control of electric light levels based on the amount of daylight in a space
- Required to control lighting in spaces with ≤ 150 watts of general lighting:
  - Sidelight daylight zones
  - Toplight daylight zones
- **Exceptions**:
  - Health care facilities where patient care is directly provided
  - Dwelling units and sleeping units
  - Lighting required for specific application control per C405.2.4
  - Sidelight daylight zones on 1st floor above grade in Group A-2 and Group M occupancies



Exterior Lighting Power Limits

Section C405.5.1

What areas are covered under exterior lighting allowances?

✓**Tradable surfaces**

Common exterior lighted needs that can be traded for other needs

- For example, wattage allowed for parking lot lighting can be "traded" and used for canopy lighting

✓**Nontradable surfaces**

Less common exterior lighted needs that cannot be traded for other needs

- These applications have more specific security or task illuminance needs

Exterior Lighting Zones

Table C405.5.2(1)

Power allowances are listed by lighting zone

Lighting Zone	Description
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas no classified as lighting zone 1, 2 or 4
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

Exterior Lighting Zones

Table C405.5.2(1)

Exterior Lighting Zones
Table C405.5.2(2)

Allowances include a base allowance plus tradeable allowance

		Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance		500 W	600 W	750 W	1300 W
Tradable Surfaces	**Uncovered Parking Areas**				
	Parking areas and drives	0.04 W/ft^2	0.06 W/ft^2	0.10 W/ft^2	0.13 W/ft^2
	Building Grounds				
	Walkways less than 10 feet wide	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
	Walkways 10 feet wide or greater Plaza areas Special Feature Areas	0.14 W/ft^2	0.14 W/ft^2	0.16 W/ft^2	0.2 W/ft^2
	Stairways	0.75 W/ft^2	1.0 W/ft^2	1.0 W/ft^2	1.0 W/ft^2
	Pedestrian Tunnels	0.15 W/ft^2	0.15 W/ft^2	0.2 W/ft^2	0.3 W/ft^2

Partial Table

Exterior Lighting Zones cont'd.

		Zone 1	Zone 2	Zone 3	Zone 4
Nontradable Surfaces	Building facades	No allowance	0.075 W/ft^2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	0.15 W/ft^2 of gross above-grade wall area
	Automated teller machines (ATM) and night depositories	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded facilities	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area	0.5 W/ft^2 of covered and uncovered area
	Drive-up window/doors	400 W per drive-through	400 W per drive-through	400 W per drive-through	400 W per drive-through
	Parking near 24-hour retail entrances	800 W per main entry	800 W per main entry	800 W per main entry	800 W per main entry

Electrical Energy Consumption Mandatory Requirement
Section C405.6

Separate metering required for each dwelling unit




NEW

Electrical Transformers
Section C405.7 - Mandatory

- Electric transformers must meet minimum efficiency requirements of Table C405.7 when tested and rated in accordance with test procedure DOE 10 CFR 431
- Efficiency to be verified through certification under an approved certification program or when program does not exist, ratings shall be supported by data furnished by transformer manufacturer

NEW

Electrical motors
Section C405.8 - Mandatory

- Electric motors must meet minimum efficiency requirements of Tables C405.8(1) through C405.8(4) when tested and rated in accordance with test procedure DOE 10 CFR 431
- Efficiency to be verified through certification under an approved certification program or when program does not exist, ratings shall be supported by data furnished by motor manufacturer

NEW

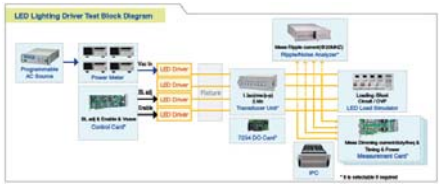
Vertical and Horizontal Transportation System and Equipment
Section C405.9.1 – Elevator Cabs

- The sum of lumens divided by the sum of the watts ≥ 35 lumens/W (not including signal and displays)
- Ventilation fans without their own air-conditioning system shall not consume ≤ 0.33 watts/cfm at the max. rated speed of the fan
- Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is stopped, unoccupied and with its doors closed for > 15 minutes

NEW

Lighting System Functional Testing
Section C408.3.1

- ✓ Prior to passing final inspection, *registered design professional* to provide evidence that lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working order per construction documents and manufacturer's installation instructions



NEW

Existing Buildings
Section *C502.2.6 Lighting Power and Systems*

New lighting systems installed as part of an addition to comply with C405

- Total interior lighting power to comply C405.4.2
  - Stand alone addition
  - Addition + existing building as a single building
- Total exterior lighting power to comply C405.5.1
  - Stand alone addition
  - Addition + existing building as a single building
- Repairs – C504.2
  - Repairs exempt where only the bulb, ballast or both within the existing luminaires in a space are replaced, provided that the replacement does not increase the installed interior lighting power

Thank You!

- Questions/comments may be addressed to me at:
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