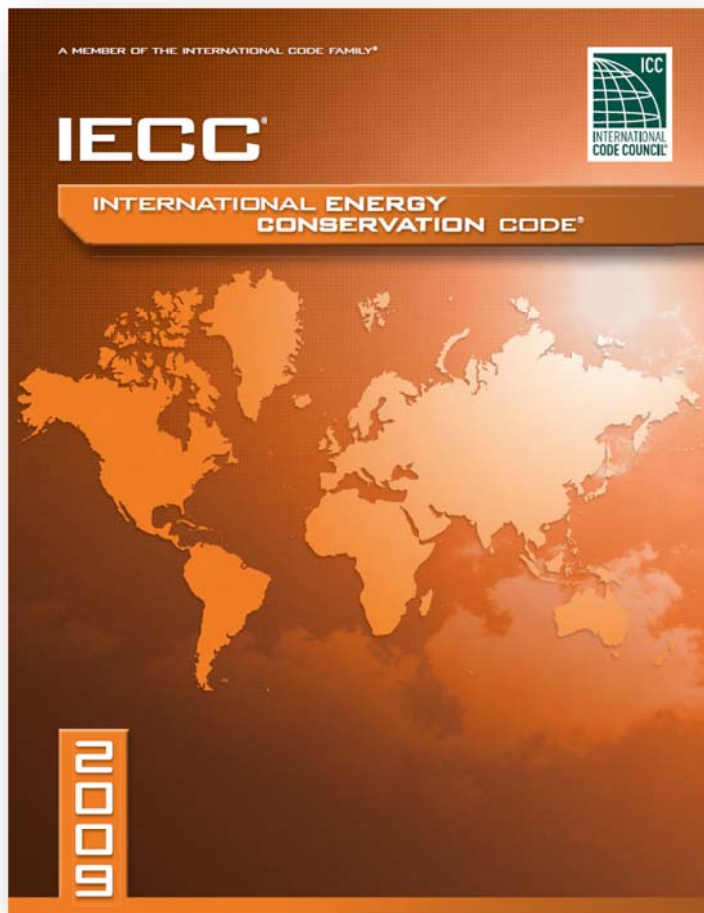


# TRAINING

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## 2009 International Energy Conservation Code With Hawaii Amendments



Hilo, Feb. 21, 2012  
Kona, Feb. 22, 2012  
Honolulu Feb. 23 & 24, 2012  
Kahului, Feb. 27, 2012  
Lihue, Feb. 28, 2012

## 2009 International Energy Conservation Code With Hawaii Amendments

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Task Order Number 2.B

## Agenda Morning Session

INTRODUCTION

8:00	Introduction
8:15	Administration and general requirements
8:30	Residential requirements
9:30	BREAK
9:45	Commercial requirements
11:15	Wrap up
11:30	Adjourn

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## Agenda Afternoon Session

INTRODUCTION

1:00	Introduction
1:15	Administration and general requirements
1:30	Residential requirements
2:30	BREAK
2:45	Commercial requirements
4:15	Wrap up
4:30	Adjourn

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## Status of County Energy Codes

INTRODUCTION

County	Version	Adoption Date
Hawaii	Amended IECC 2006	October 2010
Honolulu	Amended IECC 2006	November 2009
Kauai	Amended IECC <u>2009</u>	January 2010
Maui	Amended IECC 2006	October 2009

### Primary amendments:

- Unconditioned spaces covered
- Alternative roof insulation requirements

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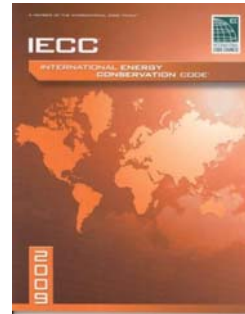
## Anticipated IECC 2009 Adoptions

INTRODUCTION

- Hawaii
- Honolulu
- Kauai
- Maui

6

- Chapter 1 Administration
- Chapter 2 Definitions
- Chapter 3 General Requirements
- Chapter 4 Residential Energy Efficiency
- Chapter 5 Commercial Energy Efficiency
- Chapter 6 Referenced Standards



New in  
2009 IECC

- General requirements
  - Roof insulation compliance when sheathing or insulation exposed in existing roof (101.4.3)
  - Commercial lighting compliance with change in space usage (101.4.4)
  - Full compliance triggered by change from unconditioned to conditioned space (101.4.5)

## What's Changed Since IECC 2006? (continued)

INTRODUCTION

New in  
2009 IECC

### • Residential requirements

- Some envelope requirements more stringent
  - Residential window SHGC = 0.30
- New requirements added
  - Building envelope tightness verification
  - Duct leakage pressure test
  - Lighting efficacy limits
  - Pool controls and covers
- Moisture control requirements (e.g., vapor retarders) moved to IRC
- No mechanical trade-offs allowed
- A few performance path assumptions changed

## What's Changed Since IECC 2006? (continued)

INTRODUCTION

New in  
2009 IECC

### • Commercial requirements

- Compliance alternative updated from ASHRAE Standard 90.1-2004 to 90.1-2007 (501.1)
- Separate envelope requirements for high-rise residential vs. other commercial (502.1.1)
- Skylight requirements more stringent (502.3)
- Updated HVAC equipment efficiency tables (503.2.3)
- Demand control ventilation for some spaces (503.2.5.1)
- Fan power limit for systems with >5hp (503.2.10)
- Supply air temperature reset for VAV systems (503.4.5.4)
- 50% high-efficacy lighting in dwelling units (505.1)
- Separate lighting control in daylight zones (505.2.2.3)
- Additional lighting power exemptions (505.5.1)
- Revised retail lighting allowance (505.5.2)
- Revised exterior lighting requirements (505.6.2)
- Expanded rules for Total Building Performance calculations (506)

## Proposed Hawaii Amendments

INTRODUCTION



- **General requirements:**
  - Envelope requirements apply also to unconditioned, habitable spaces (101.5.2)
- **Residential amendments:**
  - Wall insulation tradeoffs (Table 402.1.1)
  - Ceiling insulation alternatives (402.1.4)
  - Steel-frame wall insulation alternatives (402.2.5)
  - Exemption for north-facing and shaded windows (402.3.3)
  - Air leakage exemption for unconditioned dwellings (402.4.1.1)
  - Air leakage requirements for jalousie windows (402.4.4)

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## Proposed Hawaii Amendments (continued)

INTRODUCTION



- **Commercial amendments:**
  - No roof insulation required with cool roof membrane, if elevation < 2400 ft (502.2.1)
  - Area weighted average allowed for window SHGC compliance (502.3.3)
  - Commissioning and completion requirements (503.2.9)
  - Hotel thermostat and lighting controls (505.2.3)
  - Tenant electrical submetering (505.7)

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2009 IECC

# CHAPTER 1 ADMINISTRATION

13

## Scope

ADMINISTRATION

101.2

### Residential Requirements

- 1- and 2-family dwellings (R-3)
- Multi-family (R-2  $\leq$  3 stories )
- Residential care/assisted living (R-4  $\leq$  3 stories)



### Commercial Requirements

- All other buildings
  - Including R-1 (hotels)



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## Intent

ADMINISTRATION

### 101.3

- Regulate design and construction for effective use of energy
- Provide flexibility to permit innovation
- Not abridge safety, health or environmental requirements

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## Applicability Historic Buildings

ADMINISTRATION

### 101.4.2

- Exempt
  - State or National Register of Historic Places
  - State or local historic designation
  - Contributing resource in historic district



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## Applicability

Additions, Alterations, Renovations or Repairs

ADMINISTRATION

101.4.3

- Code applies to new and altered portions
  - Including roof insulation when sheathing or insulation exposed
- Exceptions:
  - Glass replaced in existing sash
  - Exposed roof & wall cavities that are filled with insulation
  - Construction where cavities are not exposed
  - Reroofing where sheathing not exposed
  - Lighting renovations that replace less than 50% of fixtures
  - Lighting renovations that replace only bulb/ballast

New in  
2009 IECC

17

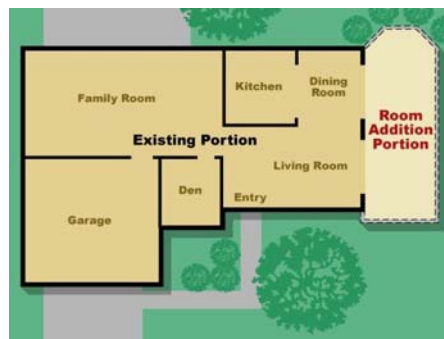
## Applicability

Additions, Alterations, Renovations or Repairs

ADMINISTRATION

101.4.3

- Options for additions:
  1. Comply on its own
  2. Existing + addition comply as single building



Source: [www.energycodes.gov](http://www.energycodes.gov)

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## Applicability Changes

ADMINISTRATION

101.4

- **Change of occupancy (101.4.4)**
  - Must comply if peak energy demand increases
    - For example, retail to restaurant
  - Commercial lighting power requirement applies (505.5) if space use changes
    - For example, retail to office
- **Change of space conditioning (101.4.5)**
  - Full compliance required for unconditioned space that is converted to conditioned space

New in  
2009 IECC

New in  
2009 IECC

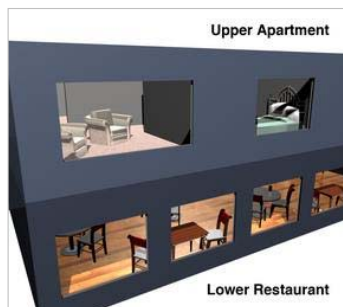
19

## Applicability Mixed Occupancy

ADMINISTRATION

101.4.6

- **Residential + commercial mixed occupancy**
  - Residential code applies to residential portions
  - Commercial code applies to commercial portions



Source: [www.energycodes.gov](http://www.energycodes.gov)

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## Compliance Low Energy Buildings

ADMINISTRATION

101.5.2

- Exempt from envelope requirements:
  1. Low-energy conditioned space
    - Peak space conditioning energy is  $< 1.0 \text{ W/ft}^2$  or  $3.4 \text{ Btu/h-ft}^2$
  2. Non-habitable unconditioned space
    - Like garages, mechanical rooms, etc.
- Applies to portions of buildings



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## Construction Documents General

ADMINISTRATION

103.1

- *...The responsible design professional shall provide on the plans a signed statement certifying that the project is in compliance with this code.*
- Exception:
  - Any building, electrical or plumbing work that is not required to be prepared, design, approved or observed by a licensed professional architect or engineer pursuant to chapter 464 Hawaii Revised Statutes



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- Section 104 deleted per Hawaii amendment



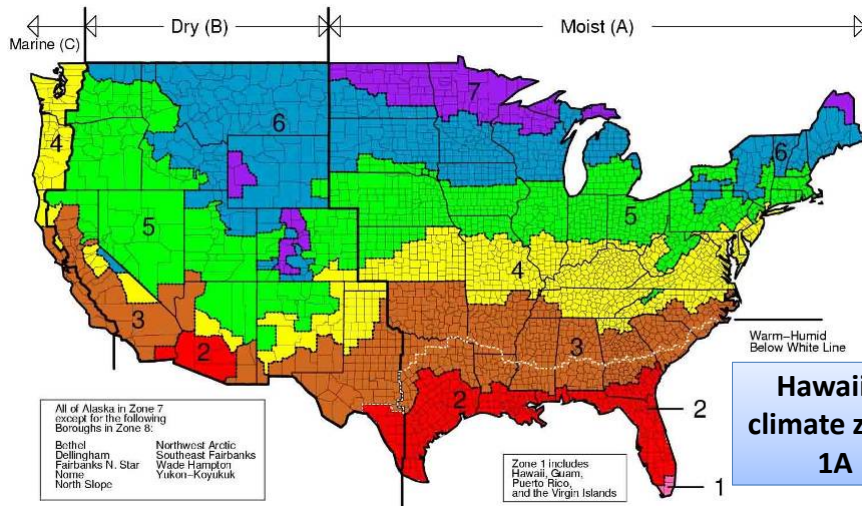
2009 IECC

## CHAPTER 3 GENERAL REQUIREMENTS

# Climate Zones

GENERAL REQUIREMENTS

301.1



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# Identification

GENERAL REQUIREMENTS

303.1

- Insulation materials
  - Marked with R-value by manufacturer
- Blown roof/ceiling insulation
  - Thickness indicated by markers
- Windows
  - Label required for SHGC



Source: www.energycodes.gov

<p>World's Best Window Co. Millennium 2000® Millennium Window Films Double Energy™ Argon Fill™ Low-E™ Product Type: Hardcoat Sider</p>	
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S.A.F.)	Solar Heat Gain Coefficient
<b>0.35</b>	<b>0.32</b>
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S.A.F.)
<b>0.51</b>	<b>0.2</b>
Condensation Resistance	
<b>51</b>	<b>—</b>

Source: 2009 IECC Code Commentary

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2009 IECC

## CHAPTER 4 RESIDENTIAL ENERGY EFFICIENCY

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### Overview of Residential Code Requirements

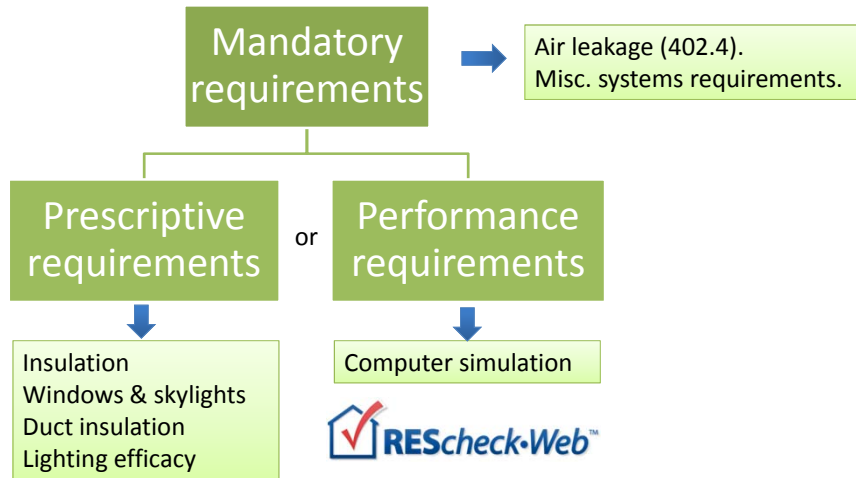
RESIDENTIAL

- Focus is envelope
  - Roof and wall insulation and alternatives
  - Window and skylight solar heat gain
  - Air leakage
- Ducts – seal, insulate, and test
- Limited AC and water heating requirements
  - Federal law sets most efficiency requirements
- No appliance requirements
- Lighting equipment
  - 50% of lamps to be high-efficacy lamps

## Compliance

RESIDENTIAL  
General

401.2



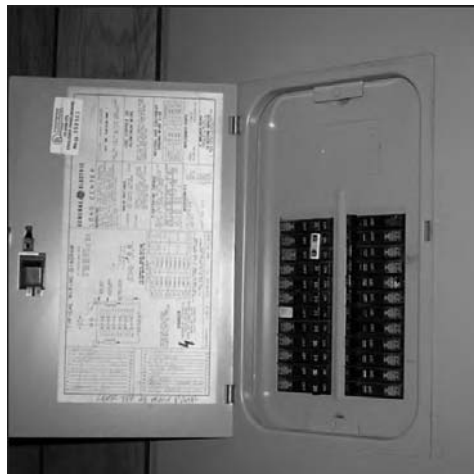
29

## Certificate

RESIDENTIAL  
General

401.3

- Post on elec. panel
- Include:
  - Insulation R-value
  - Window SHGC
  - AC efficiency



Source: 2009 IECC Code Commentary

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## Definitions

DEFINITIONS

202.

- U-factor
- Solar heat gain coefficient (SHGC)
- Shading coefficient
- Projection factor (PF)
- Radiant barrier
- Cool roof



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## Definitions Thermal Transmittance

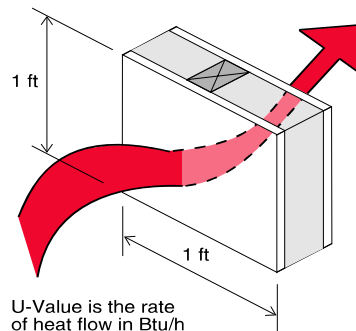
DEFINITIONS

202.

- U-factor
  - Thermal transmittance
  - Lower value = lower heat flow
  - Units = Btu/hr-°F-ft<sup>2</sup>
- U-factor = 1/R-value

$$Q = U \cdot A \cdot (T_{out} - T_{in})$$

Heat flow (Btu/hr)      Surface area (ft<sup>2</sup>)      Outdoor temperature (F)      Indoor temperature (F)



U-Value is the rate of heat flow in Btu/h through one ft<sup>2</sup> area when one side is 1° F warmer

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## Definitions SHGC vs. SC

DEFINITIONS

202.

### Solar heat gain coefficient (SHGC)

$$\text{SHGC} = \frac{\text{Solar heat gain entering the space}}{\text{Incident solar radiation}}$$

### Shading coefficient (SC)

$$\text{SC} = \frac{\text{Solar heat gain entering the space}}{\text{Solar heat gain entering the space through 1/8" clear glass}}$$

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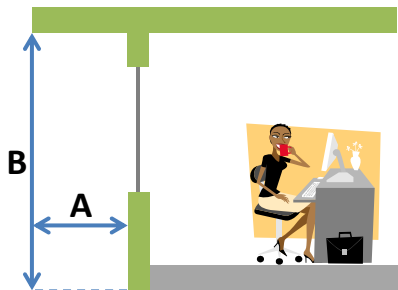
## Definitions Projection Factor (PF)

DEFINITIONS

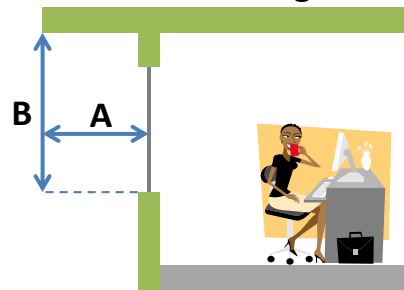


$$\text{PF} = \frac{A}{B}$$

### Wall shading



### Window shading

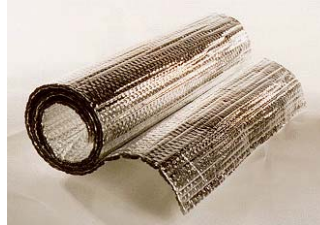


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## Definitions Radiant Barrier

### DEFINITIONS

- Low emissivity surface
- Installed with low-e surface facing air gap
- Sometimes laminated to plywood roof deck
- Cuts radiant heat transfer
  - Best for cooling load reduction through roof
  - Cuts radiant heat load on ducts from hot roof deck



Source: [www.astrofoil.net](http://www.astrofoil.net)

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## Definitions Cool Roof

### DEFINITIONS

- Reflective membrane
  - Typically white
- Several types
  - Single ply – TPO, PCV
  - Liquid applied
  - White-coated metal
- Desired properties
  - High solar reflectance
  - High emissivity
- Cool Roof Rating Council



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## General (Prescriptive) Thermal performance options

RESIDENTIAL  
Envelope

402.1

- Roof and walls
  - Minimum R-value
  - Maximum U-factor
  - Overall UA
- Windows & skylights
  - Maximum SHGC = 0.30
  - Maximum U-factor (skylights only)
  - Area-weighted average allowed
  - Some exceptions

+ Hawaii amendments  
with alternatives

+ Hawaii amendments  
with alternatives

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## General (Prescriptive) Opaque Envelope Criteria

RESIDENTIAL  
Envelope

402.1.1

IECC 2009 without Hawaii amendments	From Table 402.1.1 Minimum Insulation R-value (hr-ft <sup>2</sup> -°F/Btu)	From Table 402.1.3 Maximum U-factor (Btu/hr-ft <sup>2</sup> -°F)
Ceiling	30	0.035
Wood frame wall	13	0.082
Mass wall	3/4	0.197
Floor	13	0.064
Basement wall	0	0.360
Crawl space wall	0	0.477
Steel frame wall	13 + 5 (+3 if 24" o.c.)	0.082
Steel truss/frame ceiling	38	0.035


Section 402.2.5

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## General (Prescriptive) Opaque Envelope Criteria

RESIDENTIAL  
Envelope

402.1.1

	From Table 402.1.1	From Table 402.1.3
	Minimum Insulation R-value (hr-ft <sup>2</sup> -°F/Btu)	Maximum U-factor (Btu/hr-ft <sup>2</sup> -°F)
Ceiling	30	0.035
Wood frame wall	13	
Mass wall	3/4	
Floor	13	
Basement wall	0	
Crawl space wall	0	0.477
Steel frame wall	13 + 5 (+3 if 24" o.c.)	0.082
Steel truss/frame ceiling	38	0.035

### Wall exemptions:


1. Reflective surface ( $\geq 0.64$ )
2. 90% high efficacy lighting
3. Overhangs with projection factor  $\geq 0.30$  on non-north

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## General (Prescriptive) Opaque Envelope Criteria

RESIDENTIAL  
Envelope

402.1.1

	From Table 402.1.1	From Table 402.1.3
	Minimum Insulation R-value (hr-ft <sup>2</sup> -°F/Btu)	Maximum U-factor (Btu/hr-ft <sup>2</sup> -°F)
Ceiling	30	0.035
Wood frame wall	13	0.082
Mass wall	3/4	0.197
Floor	<del>13</del>	
Basement wall	0	
Crawl space wall	0	0.477
Steel frame wall	13 + 5 (+3 if 24" o.c.)	0.082
Steel truss/frame ceiling	38	0.035

### Raised floor:


No insulation required

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## General (Prescriptive) Opaque Envelope Criteria

RESIDENTIAL  
Envelope

402.1.1

	From Table 402.1.1	From Table 402.1.3
	Minimum Insulation R-value (hr-ft <sup>2</sup> -°F/Btu)	Maximum U-factor (Btu/hr-ft <sup>2</sup> -°F)
Ceiling	30	
Wood frame wall	13	
Mass wall	3/4	
Floor	13	
Basement wall	0	
Crawl space wall	0	
Steel frame wall	13 + 5 (+3 if 24" o.c.)	0.082
Steel truss/frame ceiling	38	0.035

**Steel frame wall exemptions:**  
(if elevation < 2,400 ft)


1. Reflective surface (≥0.64)
2. 90% high efficacy lighting
3. Overhangs with projection factor ≥ 0.30 on non-north
4. SEER 14+ air conditioner

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## General (Prescriptive) Opaque Envelope Criteria

RESIDENTIAL  
Envelope

402.1.1

	From Table 402.1.1	From Table 402.1.3
	Minimum Insulation R-value (hr-ft <sup>2</sup> -°F/Btu)	Maximum U-factor (Btu/hr-ft <sup>2</sup> -°F)
Ceiling	30	0.035
Wood frame wall	13	0.082
Mass wall	3/4	0.197
Floor	13	0.064
Basement wall	0	
Crawl space wall	0	
Steel frame wall	13 + 5 (+3 if 24" o.c.)	
Steel truss/frame ceiling	<del>38</del> 30	0.035

**Steel frame ceiling exemptions:**  
(if elevation < 2,400 ft)

1. Steep-slope roof with initial reflectance ≥ 0.25

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## General (Prescriptive) Ceiling Insulation Alternative

RESIDENTIAL  
Envelope

402.1.6

Design Option	Roof Insulation	Attic Ventilation	Radiant Barrier	Cool Roof	Roof Heat Gain Factor <0.05
1	R				
2		R	R		
3			R	R	
4					R

Applies for elevations below 2,400 ft



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## General (Prescriptive) Ceiling Insulation Alternative

RESIDENTIAL  
Envelope

402.1.6.4

- Roof Insulation
  - With attic
    - R-30 above ceiling, or
    - R-19 at roof
  - Without attic
    - R-19 between framing members, or
    - R-15 above roof deck



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## General (Prescriptive) Ceiling Insulation Alternative

RESIDENTIAL  
Envelope

402.1.6.5

- Attic ventilation
  1. Baffled ridge vent + lower openings
    - 1 ft<sup>2</sup> free vent area per 300 ft<sup>2</sup> attic
  2. Solar-powered exhaust fan
    - 1 cfm per ft<sup>2</sup> of roof
  3. Upper + lower vents
    - 1 ft<sup>2</sup> free vent area per 150 ft<sup>2</sup> attic



Combine with radiant barrier for compliance

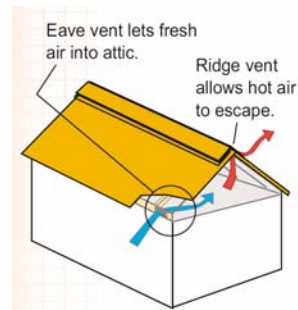
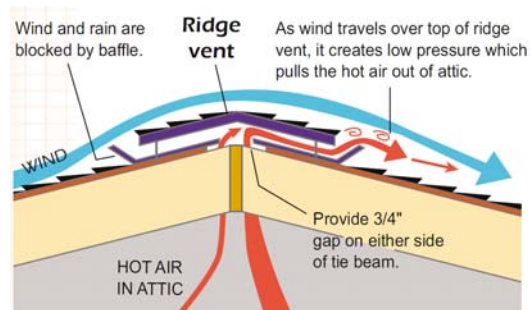
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## General (Prescriptive) Ceiling Insulation Alternative

RESIDENTIAL  
Envelope

402.1.6.5

- Attic ventilation (continued)



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## General (Prescriptive) Ceiling Insulation Alternative

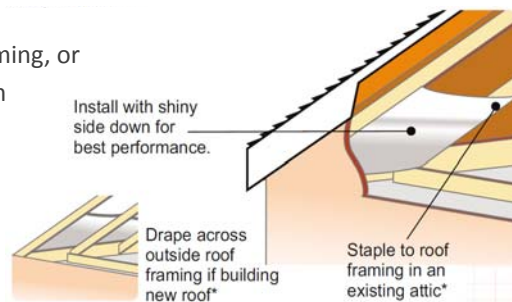
RESIDENTIAL  
Envelope

402.1.6.6

- Radiant barrier
  - Emissivity  $\leq 0.05$
  - Shiny side down
  - $\frac{3}{4}$  inch minimum air gap
  - Installation:
    - Attached to roof framing, or
    - Laminated to bottom of roof sheathing



Combine with  
radiant barrier or  
cool roof for  
compliance



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## General (Prescriptive) Ceiling Insulation Alternative

RESIDENTIAL  
Envelope

402.1.6.7

- Cool roof
  - Initial reflectance  $\geq 0.70$
  - Extended reflectance  $\geq 0.55$
  - Infrared emittance  $\geq 0.75$
  - Rated per Cool Roof Rating Council



Combine with radiant barrier for compliance

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## General (Prescriptive) Ceiling Insulation Alternative

RESIDENTIAL  
Envelope

402.1.6.8

- Roof heat gain factor  $\leq 0.05$

$$RHGF = U_r \cdot \alpha \cdot RB$$

where:

$U_r$  = roof U-factor

$\alpha$  = roof surface absorptivity (1 – reflectance)

RB = 0.33 if radiant barrier installed, otherwise 1.0

(Radiant barrier installation requirements apply)



Examples	$\alpha$	RB	Max. $U_r$	Approx. Insulation R-value
Radiant barrier only	0.70	0.33	→ 0.22	3.0
Cool roof only	0.30	1.0	→ 0.17	4.3
Radiant barrier and cool roof	0.30	0.33	→ 0.51	None

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## General (Prescriptive) Total UA Alternative

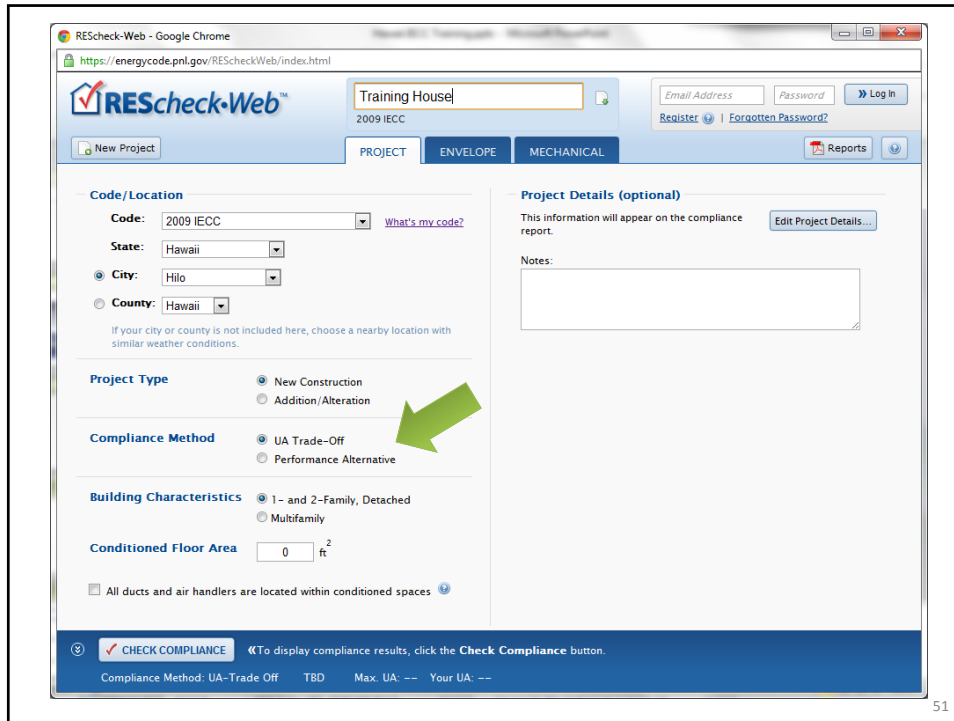
RESIDENTIAL  
Envelope

402.1.4

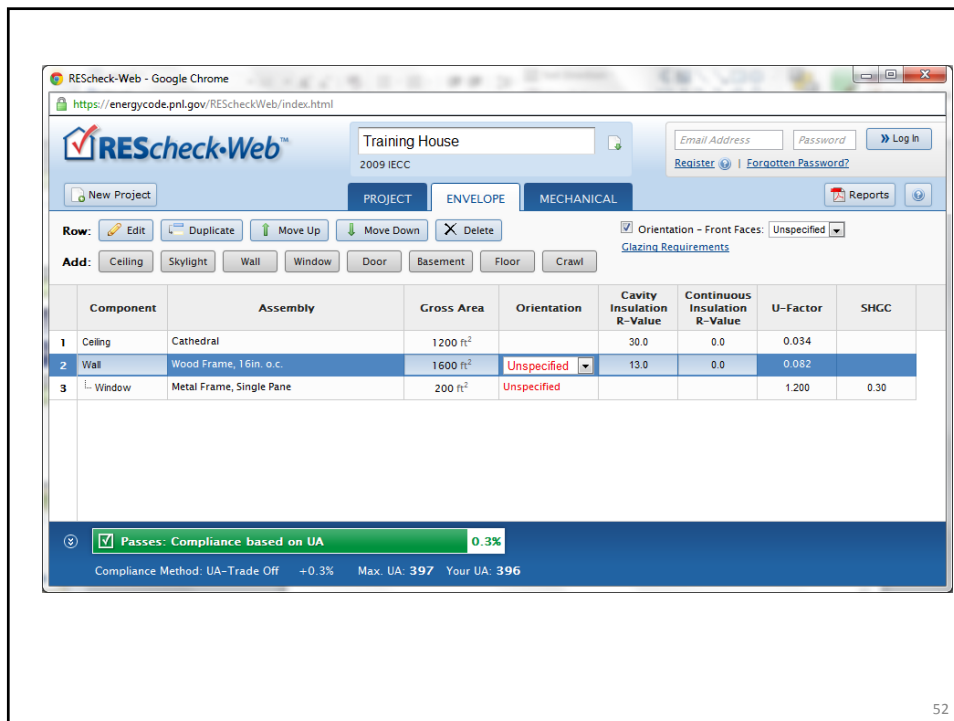
- Total building thermal envelope
  - Allows trade-offs across all envelope components
    - Based on total “UA”
      - UA – U factor x area of assembly
    - Primary approach used in REScheck software
  - Compliance:
    - Total UA your design  $\leq$  total UA with IECC U-factors



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## General (Prescriptive) Fenestration

RESIDENTIAL  
Envelope

402.3

- Windows

- Maximum U-factor = 1.20 = single-pane
- Maximum SHGC = 0.30
  - Area-weighted average allowed
- Exception for up to 15 ft<sup>2</sup>
- Hawaii exceptions
  - North-facing windows
  - Shaded windows with PF ≥ 1.0

New in  
2009 IECC



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## General (Prescriptive) Fenestration (continued)

RESIDENTIAL  
Envelope

402.3

- Skylights

- Maximum U-factor = 0.75
  - Area-weighted average allowed
- Maximum SHGC = 0.30
  - Area-weighted average allowed
- Exception for up to 15 ft<sup>2</sup>  
(skylight + window)



[www.veluxusa.com](http://www.veluxusa.com)

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## Air Leakage (Mandatory) Air Sealing and Insulation

New in  
2009 IECC

RESIDENTIAL  
Envelope

402.4.2

- Two options to demonstrate compliance
  1. Whole-house pressure test (402.4.2.1)
    - Air leakage <7 ACH when tested at pressure differential of 0.2 inches w.c.  
Testing may occur any time after rough in and installation of building envelope penetrations
  2. Field verification/visual inspection (402.4.2.2)
- Exception
  - Unconditioned residential buildings
    - Free vent area > 14% of floor area
    - Interior doors can be secured open
    - Ceiling fan stub-in



## Air Leakage (Mandatory) Air Sealing and Insulation (continued)

RESIDENTIAL  
Envelope

402.4.4

- Fenestration air leakage
  - Windows, skylights, sliding glass doors
    - Tested and labeled by manufacturer
  - Exception
    - Site built windows, skylights and doors
    - Jalousie windows  $\leq 1.2$  cfm/ft<sup>2</sup>



## Systems

RESIDENTIAL  
Systems

### 403.

#### 403.1 Controls (Mandatory)

- Thermostat

#### 403.2 Ducts

#### 403.3 Mechanical system piping insulation (Mandatory)

- R-3 insulation

#### 403.4 Circulating hot water systems (Mandatory)

- R-2 insulation
- On/off switch

#### 403.5 Mechanical ventilation (Mandatory)

- Intakes and exhausts have gravity or automatic dampers

#### 403.6 Equipment sizing (Mandatory)

#### 403.7 Systems serving multiple dwelling units (Mandatory)

- Commercial requirements apply

#### 403.9 Pools

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## Systems

RESIDENTIAL  
Systems

### Ducts

### 403.2

#### • Insulation (Prescriptive) (403.2.1)

- R-8 in attic
- R-6 elsewhere
- Exception for ducts in conditioned space

#### • Sealing (Mandatory) (403.2.2)

- Joints and seams sealed per International Residential Code
- **Testing required**

#### • Building cavities (403.2.3)

- Don't use them as ducts

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## Systems Duct Tightness Verification

New in  
2009 IECC

RESIDENTIAL  
Systems

403.2

### 1. Post construction test

- Leakage to outdoors:  $\leq 8$  cfm/per 100 ft<sup>2</sup> of conditioned floor area or
- Total leakage:  $\leq 12$  cfm/per 100 ft<sup>2</sup> of conditioned floor area
  - At pressure differential of 0.1 in w.g. (25Pa)
- All register boots taped or otherwise sealed



Source: [www.energyconservatory.com](http://www.energyconservatory.com)

### 2. Or rough-in test

- Total leakage  $\leq 6$  cfm/per 100 ft<sup>2</sup> of conditioned floor area
  - Tested at a pressure differential of 0.1 in w.g. (25Pa)
- All register boots taped or otherwise sealed
- If air handler not installed at time of test
  - Total air leakage  $\leq 4$  cfm/per 100 ft<sup>2</sup>

Exceptions: Duct tightness test is not required if the air handler and all ducts are located within conditioned space

See also:

[http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/rebatesincentives/duct\\_testing.pdf](http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/rebatesincentives/duct_testing.pdf)

## Systems Pools (Mandatory)

New in  
2009 IECC

RESIDENTIAL  
Systems

403.9

- On/off switch
- Time switch
- Cover for heated pool
  - Unless 60% solar or site recovered



Source: [www.energycodes.gov](http://www.energycodes.gov)

## Lighting Equipment (Prescriptive)

New in  
2009 IECC

RESIDENTIAL  
Power & Lighting

404.1

- A minimum of 50% of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps



Source: www.energycodes.gov

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## Definitions

New in  
2009 IECC

DEFINITIONS

202.

### High-efficacy lamps

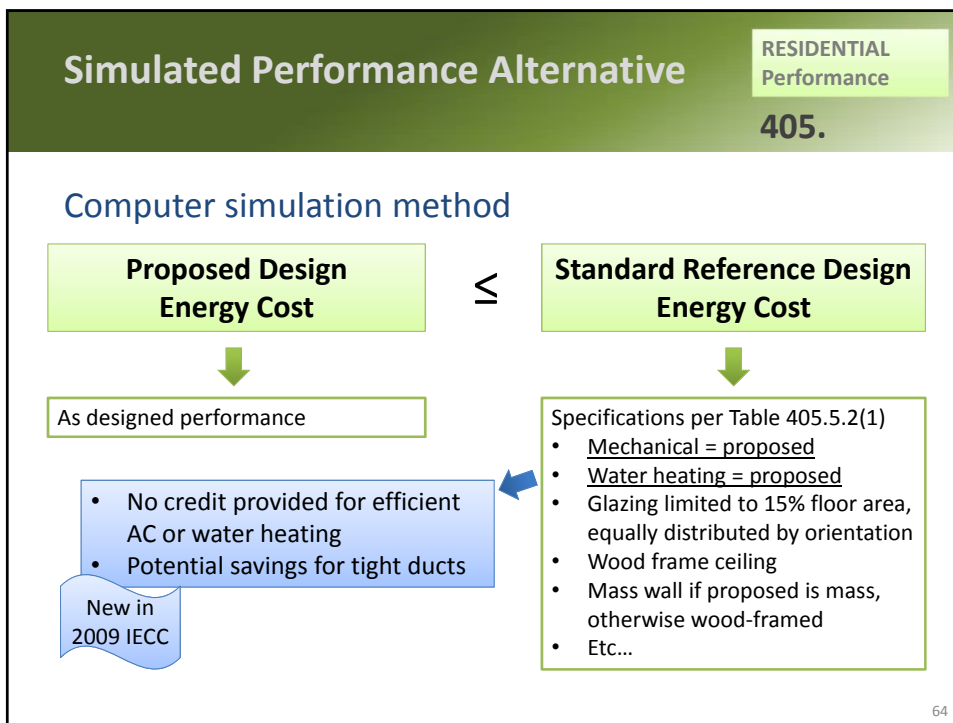
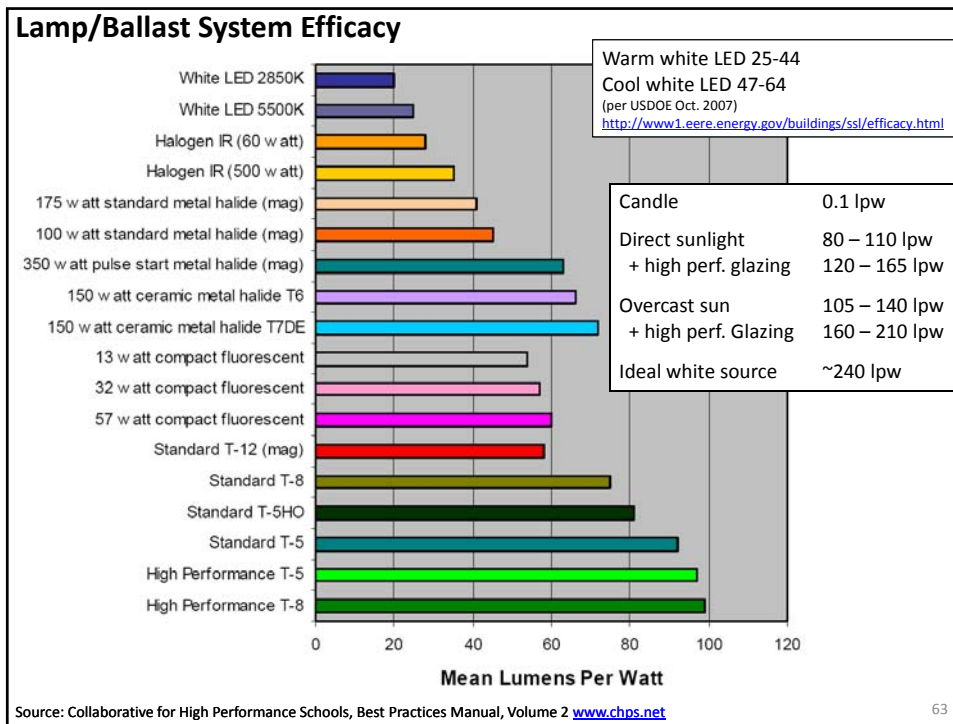
- “Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy based on lamp wattage”

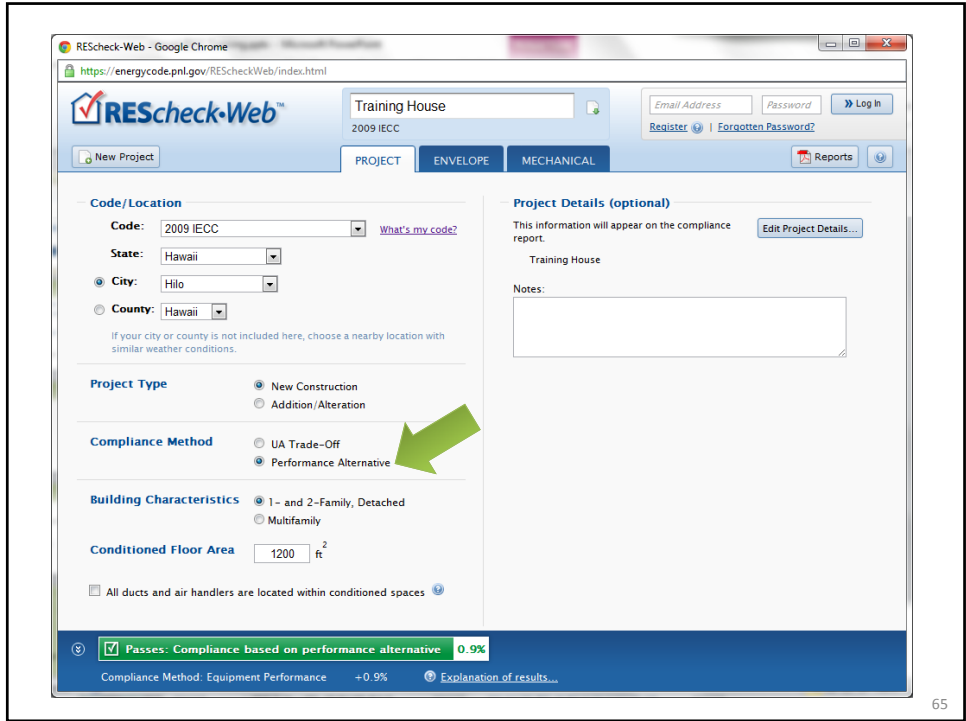
Lamp Wattage	Efficacy
> 40 watts	60 lumens/watt
15-40 watts	50 lumens/watt
< 15 watts	40 lumens/watt



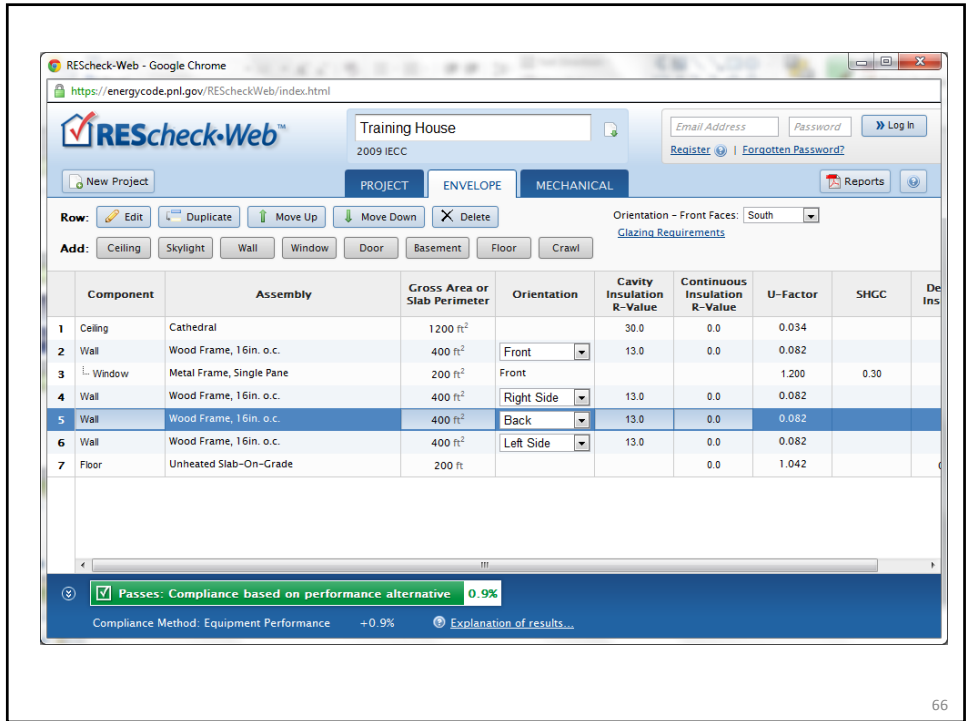
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## Residential Compliance Checklists

- Design checklist
- Plan review checklist

IECC 2009 with Hawaii Amendments					
RESIDENTIAL DESIGN CHECKLIST					
Project: _____					
Code Section	Description	Documentation Requirement	NA	Complete	
103.1	Construction documents	Signed statement on plans	<input type="checkbox"/>	<input type="checkbox"/>	
402.1	Wood frame ceiling insulation <input type="checkbox"/> Table 402.1.1 insulation R-value <input type="checkbox"/> Table 402.1.1 U-factor <input type="checkbox"/> 402.1.4 alternatives <input type="checkbox"/> 402.1.4 Total UA alternative	Insulation location and R-value indicated on plans. Radiant barrier location, if applicable. Cool roof specifications if applicable.	<input type="checkbox"/>	<input type="checkbox"/>	
402.1	Steel frame roof insulation <input type="checkbox"/> Table 402.1.1 insulation R-value <input type="checkbox"/> Table 402.1.1 U-factor <input type="checkbox"/> 402.1.4 exception <input type="checkbox"/> 402.1.4 Total UA alternative		<input type="checkbox"/>	<input type="checkbox"/>	
402.1	Wood frame wall insulation <input type="checkbox"/> Table 402.1.1 insulation R-value <input type="checkbox"/> Table 402.1.1 U-factor <input type="checkbox"/> Table 402.1.1 exceptions <input type="checkbox"/> 402.1.4 Total UA alternative		<input type="checkbox"/>	<input type="checkbox"/>	
402.1	Steel frame wall insulation <input type="checkbox"/> Table 402.1.1 insulation R-value <input type="checkbox"/> Table 402.1.1 U-factor <input type="checkbox"/> 402.1.4 exceptions <input type="checkbox"/> 402.1.4 Total UA alternative		<input type="checkbox"/>	<input type="checkbox"/>	
402.1	Masonry wall insulation <input type="checkbox"/> Table 402.1.1 insulation R-value <input type="checkbox"/> Table 402.1.1 U-factor <input type="checkbox"/> Table 402.1.1 exceptions <input type="checkbox"/> 402.1.4 Total UA alternative		<input type="checkbox"/>	<input type="checkbox"/>	
402.3	Windows <input type="checkbox"/> Table 402.3.1 SHGC $\leq 0.30$ <input type="checkbox"/> 15 ft <sup>2</sup> area exemption <input type="checkbox"/> Area-weighted average <input type="checkbox"/> North-facing window exemption <input type="checkbox"/> Shaded window exemption	SHGC indicated on plans	<input type="checkbox"/>	<input type="checkbox"/>	
402.3	Skylights <input type="checkbox"/> Table 402.3.1 SHGC $\leq 0.30$ <input type="checkbox"/> 15 ft <sup>2</sup> area exemption <input type="checkbox"/> Area-weighted average <input type="checkbox"/> Table 402.3.1 U-Factor $\leq 0.75$ <input type="checkbox"/> 15 ft <sup>2</sup> area exemption <input type="checkbox"/> Overall envelope compliance	SHGC and U-factor indicated on plans.	<input type="checkbox"/>	<input type="checkbox"/>	
402.4	Air leakage <input type="checkbox"/> Envelope sealing <input type="checkbox"/> Unconditioned dwelling exemption	Sealing requirements indicated on plans, if applicable.	<input type="checkbox"/>	<input type="checkbox"/>	

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## QUIZ! Code Applicability

- How does the code apply in the following cases:
  - New home without AC
  - Replacing 30-year old composite shingle roof with tile
  - Convert garage to bedroom
  - Install a skylight in existing roof
  - Install central AC in previously unconditioned home

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2009 IECC

# CHAPTER 5 COMMERCIAL ENERGY EFFICIENCY

69

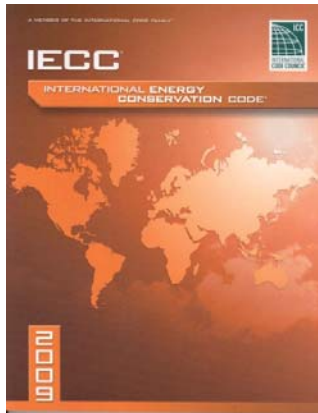
Scope

COMMERCIAL  
General

One or the other

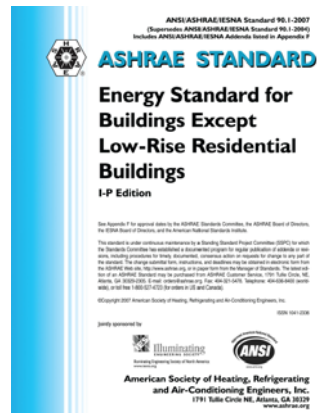
501.1

2009 IECC



or

ASHRAE Standard 90.1



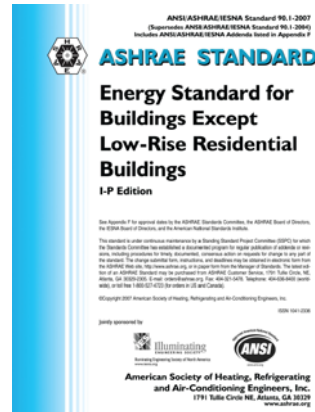
70

## Scope (continued)

COMMERCIAL  
General

501.1

- ASHRAE Standard 90.1
  - 2007 version
  - “Energy Standard for Buildings Except Low-Rise Residential Buildings”
  - Baseline for LEED 2009
  - User’s Manual available
  - [www.ashrae.org](http://www.ashrae.org)



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## Scope (continued)

COMMERCIAL  
General

501.1

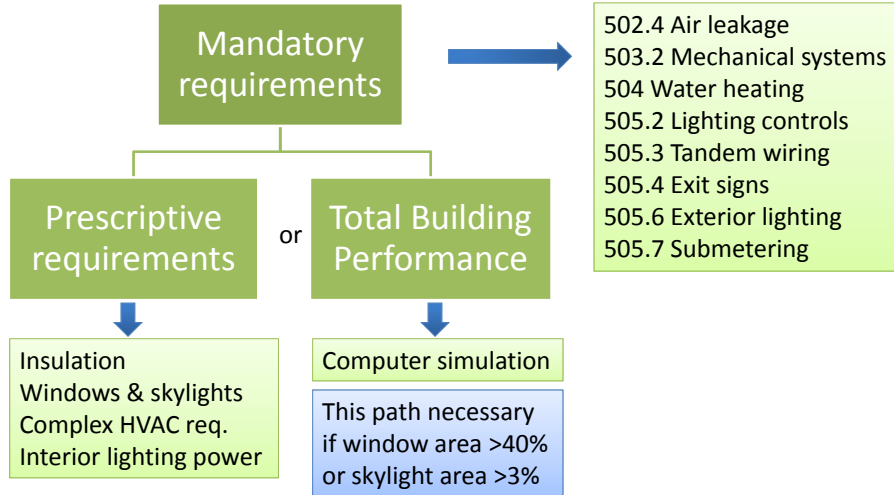
- Commercial requirements
  - Wall, roof and floor insulation
  - Windows and skylights
  - Envelope air leakage
  - Cooling equipment
  - Pumps and piping
  - Service water heating
  - Interior lighting
  - Exterior lighting
  - Commissioning
  - Electrical submetering

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# Application

COMMERCIAL  
General

501.2



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2009 IECC

## SECTION 502

## BUILDING ENVELOPE REQUIREMENTS

74

## General (Prescriptive) Roof and Wall Insulation

COMMERCIAL  
Envelope

502.1

	Type	Min. Insulation	Max. U-factor		
			Group R	Other	
Roof	Insulation entirely above deck	R-20ci	R-15ci	U-0.048	U-0.063
	Metal building	R-19 +R-5 block	R-19 +R-5 block	U-0.065	U-0.065
	Attic and other	R-38	R-30	U-0.027	U-0.034
Walls	Mass	R-5.7ci	None	U-0.151	U-0.58
	Metal building	R-16	R-16	U-0.093	U-0.093
	Metal framed	R-13	R-13	U-0.124	U-0.124
	Wood framed and other	R-13	R-13	U-0.089	U-0.089

New in  
2009 IECC

Table 502.2(1)

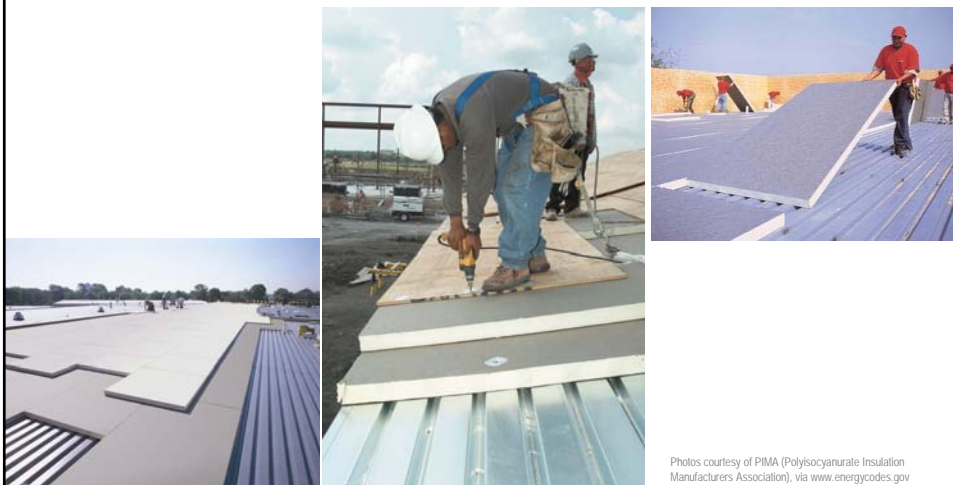
Table 502.1.2

U-factor units, Btu/hr-ft<sup>2</sup>-°F

75

## Roof Insulation Entirely Above Deck

COMMERCIAL  
Envelope



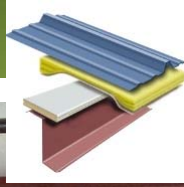
Photos courtesy of PIMA (Polysocyanurate Insulation Manufacturers Association), via [www.energycodes.gov](http://www.energycodes.gov)

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## Roof Insulation Metal Building

COMMERCIAL  
Envelope



Source: [www.energycodes.gov](http://www.energycodes.gov)

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## Roof Insulation Below Deck "Attic and Other"

COMMERCIAL  
Envelope



Source: [www.energycodes.gov](http://www.energycodes.gov)

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## Insulation Materials

COMMERCIAL  
Envelope

- **Batt insulation**
  - Fiberglass, cellulose, cotton (R-3 to R-4 per inch typical)
- **Loose fill insulation**
  - Fiberglass, cellulose (R-3 to R-4 per inch typical)
- **Foam board**
  - Polyisocyanurate (R-6/inch typical)
  - Extruded polystyrene (R-5/inch typical)
  - Expanded polystyrene (R-4/inch typical)
- **Spray foam**
  - Polyurethane (R-6/inch)
  - “Icynene” (R-3.6/inch typical)
  - Soy based (R-3.6/inch typical)
- **Straw** (R-2.4 to 3.0 per inch typical)
- **Gas-filled panels** (up to R-20/inch)
- **Aerogel** (up to R-20/inch)



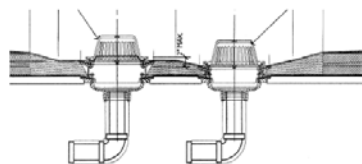
## Roof Assembly Exceptions

COMMERCIAL  
Envelope

502.2.1

For elevation < 2400 ft

1. **Tapered insulation above deck**
  - Area-weighted U-factor allowed
  - If thickness varies < 1inch
2. **Cool roof**
  - No insulation required
  - Initial reflectance  $\geq 0.70$
  - Extended reflectance  $\geq 0.55$
  - Rated per Cool Roof Rating Council



Source: [www.energycodes.gov](http://www.energycodes.gov)



## General (Prescriptive) Floor and Below Grade Wall

COMMERCIAL  
Envelope

502.1

- No insulation required in Hawaii's climate zone
  - Below grade wall
  - Floors
  - Slab-on-grade floors

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## Opaque Doors

COMMERCIAL  
Envelope

502.2.7

- If < 50% glass, then considered opaque door
- Maximum U-factor
  - Swinging doors = U-0.70
  - Roll-up or sliding doors = U-1.45
- What that means:
  - No insulation required!



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## Fenestration (Prescriptive)

COMMERCIAL  
Envelope

502.3

- Fenestration (window and skylight) requirements
  - Maximum area
  - Maximum U-factor
  - Maximum solar heat gain coefficient (SHGC)



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## Fenestration (Prescriptive) Maximum Area

COMMERCIAL  
Envelope

502.3.1

- Windows
  - Maximum 40% of gross wall area
- Skylights
  - Maximum 3% of gross roof area
- Otherwise
  - Use Total Building Performance option



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## Fenestration (Prescriptive) Maximum U-factor

COMMERCIAL  
Envelope

502.3.2

- Windows  $\leq$  U-1.20
  - Single-pane glazing in metal frame
- Skylights  $\leq$  U-0.75
  - Double-pane with thermal-break metal frame
  - Double-pane low-e with metal frame
  - Tubular skylight

New in  
2009 IECC

TABLE 303.1.3(1)  
DEFAULT GLAZED FENESTRATION U-FACTOR

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			

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## Fenestration (Prescriptive) Projection Factor Definition

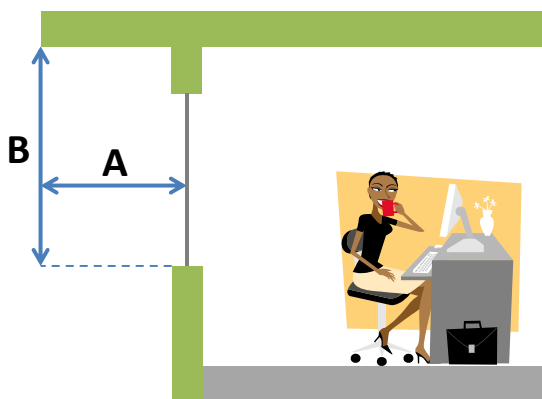
COMMERCIAL  
Envelope

502.3.2



Projection  
Factor

$$PF = \frac{A}{B}$$

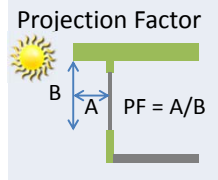
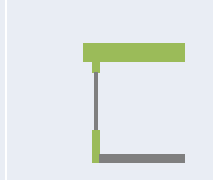
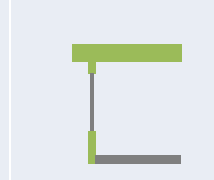
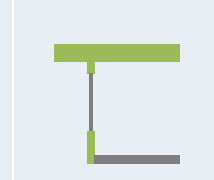


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## Fenestration (Prescriptive) Maximum SHGC

COMMERCIAL  
Envelope

502.3.2

Projection Factor			
			
	< 0.25	$0.25 \leq PF < 0.50$	$\geq 0.5$
<b>Maximum SHGC</b>	<b>0.25</b>	<b>0.33</b>	<b>0.40</b>

Skylight max. SHGC is 0.35

Otherwise, use area-weighted average or Total Building Performance option

TABLE 303.1.3(3)  
DEFAULT GLAZED FENESTRATION SHGC

SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
Clear	Tinted	Clear	Tinted	
0.8	0.7	0.7	0.6	0.6

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## Fenestration (Prescriptive) Area-weighted average

COMMERCIAL  
Envelope

502.3.3

- Area-weighted SHGC allowed for commercial fenestration compliance
  - Some windows can exceed limit if average complies
  - Section added as Hawaii amendment



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## Solar Control Strategies

1. Orientation
2. Exterior shading – fixed
3. Exterior shading – operable
4. High performance glazing



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## Solar Control Strategies

### 1. Orientation

North  
↑



**Worst = Long sides face east/west**

Low sun angles create glare and heat

Require complex shading systems that also block the view



**Ideal = Long sides face north/south**

North side diffuse daylight

South side can be passively shaded most of the year without blocking view glazing

East and west sides can have minimal fenestration

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## Solar Control Strategies 2. Fixed exterior shades

Sidefin



Overhang and lightshef



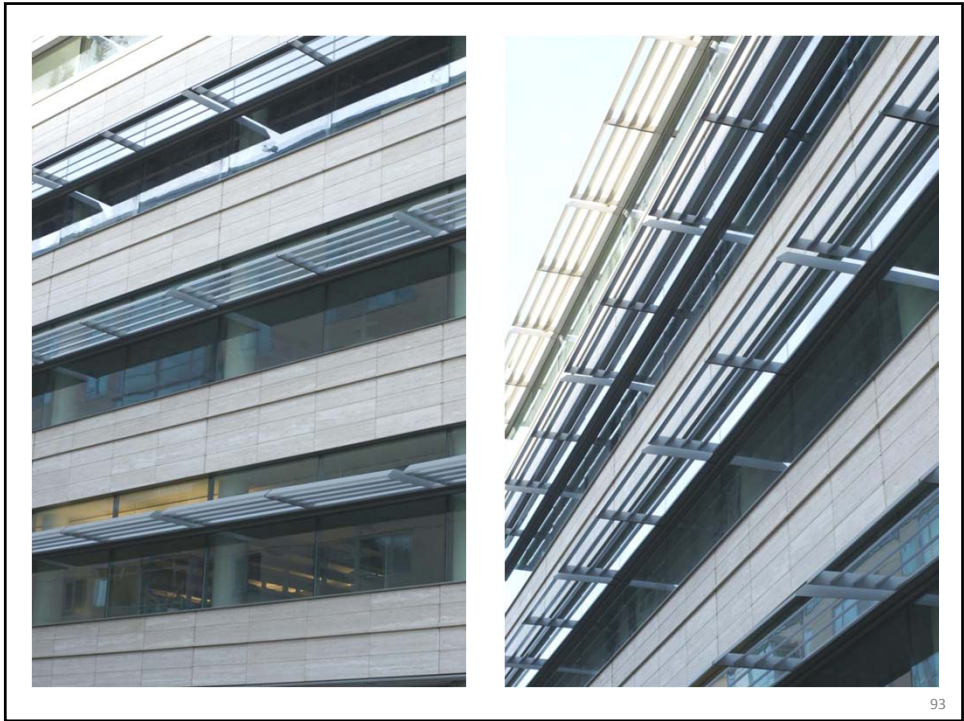
91

## Solar Control Strategies 2. Fixed exterior shades



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### Solar Control Strategies

#### 3. Operable exterior shades



[www.suncontrollers.com](http://www.suncontrollers.com)

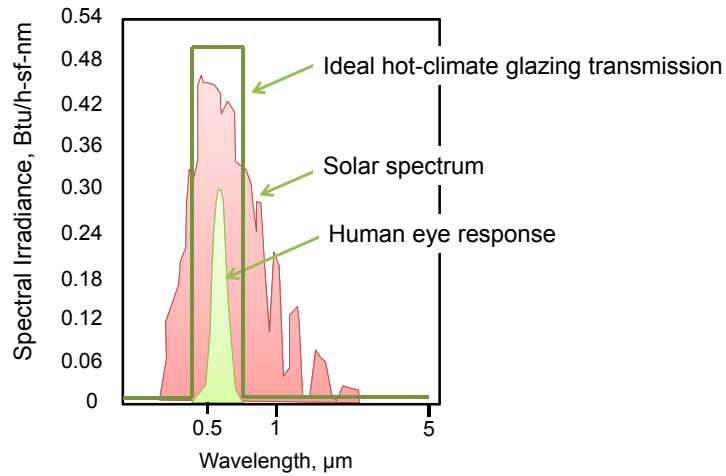
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## Solar Control Strategies

### 4. High Performance Glazing



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## Solar Control Strategies

### 4. High Performance Glazing (continued)

- Tinted (heat-absorbing) glass

- Pigment within glass
- Absorbs radiation, heats up
- “High performance” tints
  - Higher VLT/SHGC ratio
  - “Spectrally selective”

VLT = visible light transmittance

Glass Type (all ¼ in.)	SHGC	VLT	VLT/SHGC ratio
clear	0.82	0.88	1.1
gray	0.60	0.47	0.78
bronze	0.62	0.53	0.86
green	0.61	0.77	1.26
blue-green	0.63	0.76	1.20
“high perf.” blue	0.51	0.68	1.34

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## Solar Control Strategies

### 4. High Performance Glazing (continued)

- Low-emissivity (“low-e”) coatings
  - Reduce radiant heat transfer within air gap (better U-factor)
  - Can be “spectrally selective”
- Reflective coatings
  - May or may not be low-e
  - Highly reflective in visible and infrared spectra
  - Low visible light transmittance (VLT)
- “Hard” vs. “soft” coatings
  - Hard (pyrolytic) applied while glass is manufactured
  - Soft applied in vacuum chamber to individual pieces of glass
    - Provide lower emissivity, better performance
    - Can be scratched

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## Solar Control Strategies

### 4. High Performance Glazing (continued)

Name	Glass Type	Coating	U-factor (center of glass)	SHGC	VLT	VLT/ SHGC ratio
Clear	¼" clear	None	1.02	0.82	0.88	1.1
Double Clear	¼" clear / ¼" clear	None	0.47	0.70	0.79	1.1
VE1-85	¼" clear / ¼" clear	Low-e	0.31	0.54	0.76	1.4
VE1-55	¼" clear / ¼" clear	Low-e	0.31	0.35	0.47	1.3
VE2-55	¼" green / ¼" clear	Low-e	0.31	0.26	0.40	1.5
VE4-55	¼" gray / ¼" clear	Low-e	0.31	0.25	0.27	1.1

Source: [www.viracon.com](http://www.viracon.com)

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## Air Leakage (Mandatory)

COMMERCIAL  
Envelope

### 502.4

- 502.4.1 Window and door assemblies
- 502.4.2 Curtain wall, storefront glazing and commercial entrance doors
- 502.4.3 Sealing of the building envelope
- 502.4.4 Outdoor air intakes and exhaust openings
- 502.4.6 Loading dock weatherseals
- 502.4.8 Recessed lighting

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2009 IECC

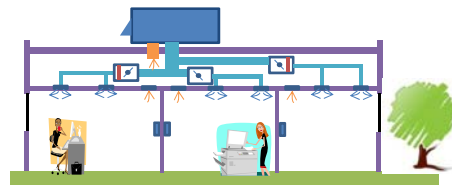
## SECTION 503 BUILDING MECHANICAL SYSTEMS

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Mandatory  
requirements  
(503.2 )

Simple system  
requirements  
(503.3)

Complex system  
requirements  
(503.4)



- 503.2.1 Calculation of heating and cooling loads
- 503.2.2 Equipment and system sizing
- 503.2.3 HVAC equipment performance requirements
- 503.2.4 HVAC system controls
- 503.2.5 Ventilation
- 503.2.6 Energy recovery ventilation systems
- 503.2.7 Duct and plenum insulation and sealing
- 503.2.8 Piping insulation
- 503.2.9 Mechanical system commissioning
- 503.2.10 Air system design and control

## Mandatory Requirements

HVAC equipment performance requirements

COMMERCIAL  
Mechanical

503.2.3

- Minimum efficiency tables for:
  - Unitary air conditioners (SEER, EER, IPLV)
  - Packaged terminal air conditioners (EER)
  - Furnaces (AFUE,  $E_c$ ,  $E_t$ )
  - Boilers (AFUE,  $E_c$ ,  $E_t$ )
  - Condensing units (EER, IPLV)
  - Chillers (EER, kW/ton)
  - Cooling towers (gpm/hp)
- Equal to Standard 90.1-2007



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## Mandatory Requirements

HVAC equipment performance requirements

COMMERCIAL  
Mechanical

503.2.3

### Comparison of 2006 to 2009



Cooling Capacity (kBtu/hr)	2006 IECC	2009 IECC
< 65 (packaged)	10.0 SEER	13.0 SEER
< 65 (split)	9.7 SEER	13.0 SEER
65 – 135	10.3 EER	11.2 EER
135 – 240	9.7 EER	11.0 EER
240 – 760	9.5 EER	10.0 EER
> 760	9.2 EER	9.7 EER

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## Mandatory Requirements HVAC System Controls

COMMERCIAL  
Mechanical

503.2.4

- Thermostatic control (503.2.4.1)
- Off-hour control (503.2.4.3)
  - Automatic setback and shutdown
- Shutoff damper controls (503.2.4.4)

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## Mandatory Requirements Ventilation

COMMERCIAL  
Mechanical

503.2.5

- Outdoor air per International Mechanical Code
  - Natural or mechanical
- Demand controlled ventilation (503.2.5.1)
  - If space > 500 ft<sup>2</sup>
  - And > 40 people / 1000 ft<sup>2</sup>
  - And system outdoor air > 3,000 cfm

New in  
2009 IECC

Theater, auditorium, ballroom, etc.



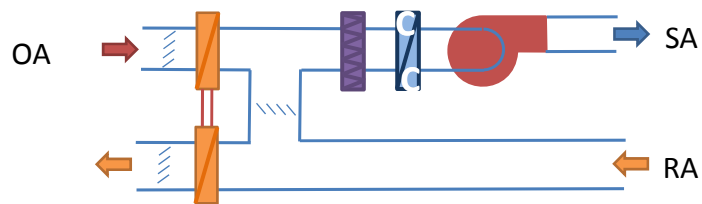
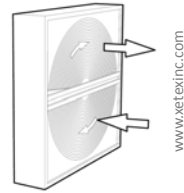
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## Mandatory Requirements Energy Recovery Ventilation

COMMERCIAL  
Mechanical

503.2.6

- Energy recovery required if:
  - Supply air  $\geq 5,000$  cfm
  - Outdoor air fraction  $\geq 70\%$
- Some exceptions apply



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## Mandatory Requirements Duct and Plenum Insulation & Sealing

COMMERCIAL  
Mechanical

503.2.7

- Insulate supply ducts, return ducts, and plenums:
  - R-5 in unconditioned spaces
  - R-8 outside
- Duct construction requirements (503.2.7.1)



Source: [www.energycodes.gov](http://www.energycodes.gov)

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## Mandatory Requirements Piping Insulation

COMMERCIAL  
Mechanical

503.2.8

TABLE 503.2.8  
MINIMUM PIPE INSULATION  
(thickness in inches)

FLUID	NOMINAL PIPE DIAMETER	
	≤ 1.5"	> 1.5"
Steam	1½	3
Hot water	1½	2
Chilled water, brine or refrigerant	1½	1½

Some  
exceptions  
apply

For SI: 1 inch = 25.4 mm.

a. Based on insulation having a conductivity ( $k$ ) not exceeding 0.27 Btu per inch/h · ft<sup>2</sup> · °F.

b. For insulation with a thermal conductivity not equal to 0.27 Btu · inch/h · ft<sup>2</sup> · °F at a mean temperature of 75°F, the minimum required pipe thickness is adjusted using the following equation:

$$T = r[(1 + t/k)^{K-1}]$$

where:

$T$  = Adjusted insulation thickness (in).

$r$  = Actual pipe radius (in).

$t$  = Insulation thickness from applicable cell in table (in).

$K$  = New thermal conductivity at 75°F (Btu · in/hr · ft<sup>2</sup> · °F).

$k$  = 0.27 Btu · in/hr · ft<sup>2</sup> · °F.

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## Mandatory Requirements Commissioning & Completion

COMMERCIAL  
Mechanical

503.2.9

"Prior to the issuance of a certificate of occupancy, the design professional shall provide a written statement of system completion in accordance with Sections 503.2.9.1 through 503.2.9.3."



- System commissioning (503.2.9.1)
- Commissioning plan (503.2.9.2)
- Systems adjusting and balancing (503.2.9.3)
  - Air balancing
  - Hydronic balancing

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# Mandatory Requirements Air System Design & Control

New in  
2009 IECC

COMMERCIAL  
Mechanical

503.2.10

- Allowable fan horsepower (503.2.10.1)

TABLE 503.2.10.1(1)  
FAN POWER LIMITATION

	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	$hp \leq CFM_s * 0.0011$	$hp \leq CFM_s * 0.0015$
Option 2: Fan system bhp	Allowable fan system bhp	$bhp \leq CFM_s * 0.00094 + A$	$bhp \leq CFM_s * 0.0013 + A$

where:

CFM<sub>s</sub> = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.

hp = The maximum combined motor nameplate horsepower.

Bhp = The maximum combined fan brake horsepower.

A = Sum of  $[PD \times CFM_d / 4131]$ .

where:

PD = Each applicable pressure drop adjustment from Table 503.2.10.1(2) in. w.c.

CFM<sub>d</sub> = The design airflow through each applicable device from Table 503.2.10.1(2) in cubic feet per minute.



113

# Mandatory Requirements Air System Design & Control

New in  
2009 IECC

COMMERCIAL  
Mechanical

503.2.10

- Allowable fan horsepower (continued)

TABLE 503.2.10.1(2)  
FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT

DEVICE	ADJUSTMENT
<b>Credits</b>	
Fully ducted return and/or exhaust air systems	0.5 in w.c.
Return and/or exhaust airflow 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.
Heat recovery device	Pressure drop of device at fan system design condition.
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design conditions
Sound attenuation section	0.15 in w.c.
<b>Deductions</b>	
Fume hood exhaust exception (required if Section 503.2.10.1, Exception 3, is taken)	-1.0 in w.c.

114

## Mandatory Requirements Air System Design & Control

New in  
2009 IECC

COMMERCIAL  
Mechanical

503.2.10

- Motor nameplate horsepower (503.2.10.2)
  - Must list brake horsepower on plans
  - Limits oversizing of fan motors



115

## Simple HVAC Systems (Prescriptive)

COMMERCIAL  
Mechanical

503.3

- Mandatory requirements apply
- That's it!
  - Economizers not required in Hawaii climate (503.3.1)



116

## Complex HVAC Systems (Prescriptive)

COMMERCIAL  
Mechanical

### 503.4

- 503.4.1 Economizers
- 503.4.2 VAV fan control
- 503.4.3 Hydronic system controls
- 503.4.4 Heat rejection equipment fan speed control
- 503.4.5 Systems serving multiple zones
- 503.4.6 Heat recovery for service water heating
- 503.4.7 Hot gas bypass limitation

117

## Complex HVAC Systems (Prescriptive)

COMMERCIAL  
Mechanical

### VAV Fan Control

### 503.4.2

- Variable air volume (VAV) fans
  - If motor  $\geq 10$  hp
  - Then variable speed drive required



118

## Complex HVAC Systems (Prescriptive) Hydronic Controls

COMMERCIAL  
Mechanical

503.4.3

- Part load controls (503.4.3.4)
  - If capacity  $\geq 300,000$  Btu/hr (25 tons)
    - Then supply water temperature reset required
    - And variable flow required
- Pump isolation (503.4.3.5)
  - If multiple chillers
  - Then be able to shut flow through individual chillers

New in  
2009 IECC



119

## Complex HVAC Systems (Prescriptive) Heat Rejection Equipment Fan Speed Control

COMMERCIAL  
Mechanical

503.4.4

- Cooling tower fans
  - If fan motor  $\geq 7.5$  hp
  - Then must be 2-speed or variable speed
  - And automatic control



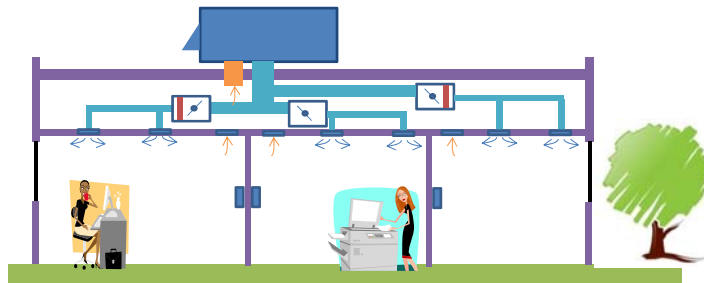
120

## Complex HVAC Systems (Prescriptive) Systems Serving Multiple Zones

COMMERCIAL  
Mechanical

503.4.5

- Variable air volume required
  - With exceptions
- Supply air temperature reset control (503.4.5.4)
  - Unless system prevents reheat



121

## Complex HVAC Systems (Prescriptive) Heat Recovery for Service Water Heating

COMMERCIAL  
Mechanical

503.4.6

- Condenser heat recovery required
  - If facility operates 24 hours/day
  - And cooling tower capacity > 6,000,000 Btu/hr (500 tons)
  - And water heating load > 1,000,000 Btu/hr (~2,400 gal/hr)
- Requirement
  - Recover 60% of rejected heat at design conditions
  - Or preheat water to 85°F
- Exceptions
  - When condenser heat recovery used for space reheat
  - Solar water heating systems

122

## Complex HVAC Systems (Prescriptive) Hot Gas Bypass Limitation

COMMERCIAL  
Mechanical

503.4.7

- Applies if cooling capacity > 90,000 Btu/hr (7.5 tons)
- Hot gas bypass not allowed unless:
  - Multiple unloading or continuous capacity modulation
  - Limited to capacity in table 503.4.7

TABLE 503.4.7  
MAXIMUM HOT GAS BYPASS CAPACITY

RATED CAPACITY	MAXIMUM HOT GAS BYPASS CAPACITY (% of total capacity)
≤ 240,000 Btu/h	50%
> 240,000 Btu/h	25%

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2009 IECC

## SECTION 504 SERVICE WATER HEATING

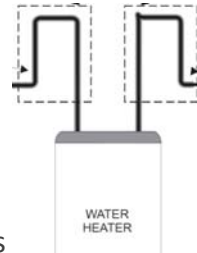
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## Service Water Heating

COMMERCIAL  
Water Heating

### 504.

- 504.2 Equipment performance efficiency
- 504.3 Temperature controls
- 504.4 Heat traps
- 504.5 Pipe insulation
  - 1 inch for recirculating systems
  - ½ inch on first 8 ft in non-recirculating systems
- 504.6 Hot water system controls
  - Auto or manual control of circulation pump or heat trace



125

## Service Water Heating Pools

COMMERCIAL  
Water Heating

### 504.7

- On/off switch
- Time switch
- Cover for heated pool
  - Unless 60% solar or site recovered



Source: [www.energycodes.gov](http://www.energycodes.gov)

126



2009 IECC

## SECTION 505 ELECTRICAL POWER & LIGHTING SYSTEMS

127

### Electrical Power and Lighting Systems

COMMERCIAL  
Power & Lighting

#### 505.

- 505.1 General (Mandatory)
- 505.2 Lighting controls (Mandatory)
- 505.3 Tandem wiring (Mandatory)
- 505.4 Exit signs (Mandatory)
- 505.5 Interior lighting power requirements (Prescriptive)
- 505.6 Exterior lighting power (Mandatory)
- 505.7 Electrical energy consumption (Mandatory)

128

## Electrical Power and Lighting Systems

COMMERCIAL  
Power & Lighting

505.

- Requirements apply:
  - New lighting system
  - Renovation of existing lighting system
  - Change in occupancy that increases energy (101.4.4)
- Exceptions:
  - Historic buildings (101.4.2)
  - Lighting in dwelling units
    - If  $\geq 50\%$  of fixtures are high efficacy (505.1)
  - Renovations that replace fewer than 50% of fixtures (101.4.3)
  - Renovations that replace only bulb/ballast (101.4.3)

New in  
2009 IECC

129

## Definitions

DEFINITIONS

202.

### High-efficacy lamps

- “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



130

## Lighting Controls (Mandatory) Interior Lighting Controls

COMMERCIAL  
Power & Lighting

505.2.1

- Manual control for each space
  - Exceptions:
    - Security or emergency areas
    - Egress stairways or corridors



131

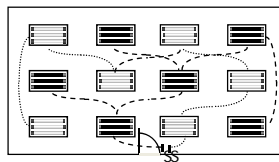
## Lighting Controls (Mandatory) Light Reduction Controls

COMMERCIAL  
Power & Lighting

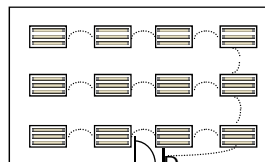
505.2.2.1

- Allow occupants to reduce lighting
  - By at least 50%
  - In a reasonably uniform illumination pattern

Alternating Luminaires

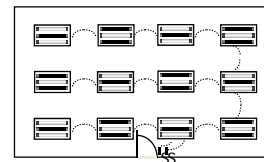


Dimming All Fixtures



Dimmer Switch

Alternating Lamps



Source: [www.energycodes.gov](http://www.energycodes.gov)

132

## Lighting Controls (Mandatory) Light Reduction Controls (continued)

COMMERCIAL  
Power & Lighting

505.2.2.1

- **Exceptions:**
  - Areas with only one luminaire
  - Areas controlled by occupancy sensor
  - Corridors, storerooms, restrooms or public lobbies
  - Sleeping units
  - Spaces with  $<0.6$  w/ft<sup>2</sup>



Source: [www.energycodes.gov](http://www.energycodes.gov)

133

## Lighting Controls (Mandatory) Automatic Lighting Shutoff

COMMERCIAL  
Power & Lighting

505.2.2.2

- **Automatic shutoff in buildings  $>5,000$  ft<sup>2</sup>**
  - Time-of-day schedule
  - Occupant sensor
- **Exceptions**
  - Sleeping unit
  - Patient care spaces
  - Occupant safety
- **Occupant override (505.2.2.2.1)**
- **Holiday scheduling (505.2.2.2.2)**



134

## Lighting Controls (Mandatory) Daylight Zone Control

New in  
2009 IECC

COMMERCIAL  
Power & Lighting

505.2.2.3

- Separate controls for lighting in daylight zones
  - Exception: spaces with 2 or fewer fixtures

Adjacent to vertical fenestration



Under skylights



See definition of "DAYLIGHT ZONE" in Section 202

135

## Lighting Controls (Mandatory) Sleeping Unit Controls

COMMERCIAL  
Power & Lighting

505.2.3

Sleeping units in Group R-1 occupancies shall be equipped with a method of adjusting thermostat set points and turning off all permanently installed light fixtures and all outlets powering portable light fixtures and entertainment devices when the unit is unoccupied.

Exception: Bathroom night lights, not exceeding 3 watts

...



136

## Lighting Controls (Mandatory) Sleeping Unit Controls (continued)

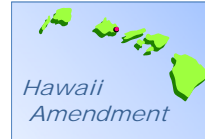
COMMERCIAL  
Power & Lighting

505.2.3

...  
Each sleeping unit in Group R-1 occupancies shall be equipped with one or more of the following devices or systems:

1. A master switch at the main entry door activated by a room card that must be inserted upon entry,
2. A sensor capable of detecting when the room is occupied, or
3. An electronic control system capable of detecting when the room is occupied.

...



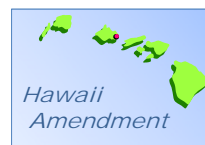
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## Lighting Controls (Mandatory) Sleeping Unit Controls (continued)

COMMERCIAL  
Power & Lighting

505.2.3

...  
Operable doors leading from a conditioned space to a balcony or patio in sleeping units of Group R-1 occupancies shall be provided with interlock controls to disable heating and cooling of the space while the door is open.



138

## Lighting Controls (Mandatory) Exterior Lighting Controls

COMMERCIAL  
Power & Lighting

505.2.4

- For dusk-to-dawn lighting:
  - Astronomical time switch or photosensor
- For all other:
  - Astronomical time switch OR photosensor + time switch
- Time switches must have 10 hour battery backup



Source: www.energycodes.gov

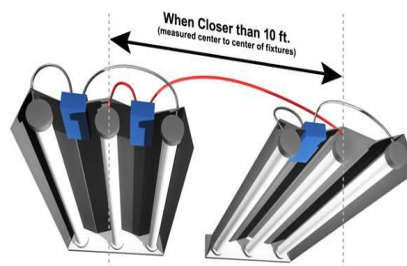
139

## Tandem Wiring

COMMERCIAL  
Power & Lighting

505.3

- Tandem wiring for all odd-numbered lamp configurations
- Exceptions:
  - Where electronic high frequency ballasts are used
  - Luminaires on emergency circuits
  - Luminaires with no available pair in the same area



Source: www.energycodes.gov

Intent: Eliminate the use of magnetic ballasts driving single lamps!

140

## Exit Signs

COMMERCIAL  
Power & Lighting

505.4

- Internally illuminated exit signs shall not exceed 5 watts per side



Source: www.energycodes.gov

141

## Interior Lighting Power Requirements (Prescriptive)

COMMERCIAL  
Power & Lighting

505.5

**Connected  
Lighting Power  
(505.5.1)**

≤

**Interior Lighting Power  
Allowance  
(505.5.2)**

- Exceptions (505.5.1)
- Screw lamp holders (505.5.1.1)
- Low-voltage lighting (505.5.1.2)
- Other luminaires (505.5.1.3)
- Line-voltage track and plug-in busway (505.5.1.4)

- W/ft<sup>2</sup> allowance (Table 505.5.2)
- Additional retail allowance (footnote to Table 505.5.2)

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# Interior Lighting Power Requirements Exceptions

COMMERCIAL  
Power & Lighting

## 505.5.1

- Connected power for following not included in calculations:
  - Professional sports arena playing field
  - Sleeping unit lighting
  - Emergency lighting automatically off during normal building operation
  - Lighting in spaces specifically designed for use by occupants with special lighting needs including visual impairment and other medical and age related issues
  - Lighting in interior spaces specifically designated as a registered interior historic landmark
  - Casino gaming areas
- Lighting equipment used for the following exempt if in addition to general lighting and controlled by an independent control device
  - Task lighting for medical and dental procedures
  - Display lighting for exhibits in galleries, museums and monuments
- Theatrical, stage, film, and video production
- Used for photographic processes
- Integral to equipment or instrumentation installed by manufacturer
- Plant growth or maintenance
- Advertising or directional signage
- Food warming and food prep equipment (in restaurant buildings and areas)
- Lighting equipment that is for sale
- Lighting demonstration equipment in lighting education facilities
- Approved because of safety or emergency considerations, exclusive of exit lights
- Integral to both open and glass-enclosed refrigerator and freezer cases
- In retail display windows when the display is enclosed by ceiling-height partitions
- Furniture-mounted supplemental task lighting controlled by automatic shutoff

New in  
2009 IECC

143

# Interior Lighting Power Requirements Allowance – Table 505.5.2

COMMERCIAL  
Power & Lighting

## 505.5.2

LIGHTING POWER DENSITY	
Building Area Type <sup>a</sup>	(W/m <sup>2</sup> )
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.6
Dormitory	1.0
Exercise Center	1.0
Gymnasium	1.1
Healthcare—clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing Facility	1.3
Motel	1.0
Motion Picture Theater	1.2
Multifamily	0.7
Museum	1.1
Office	1.0
Parking Garage	0.3

LIGHTING POWER DENSITY	
Building Area Type <sup>a</sup>	(W/m <sup>2</sup> )
Penitentiary	1.0
Performing Arts Theater	1.6
Police/Fire Station	1.0
Post Office	1.1
Religious Building	1.3
Retail <sup>b</sup>	1.5
School/University	1.2
Sports Arena	1.1
Town Hall	1.1
Transportation	1.0
Warehouse	0.8
Workshop	1.4

For buildings with more than one area type, sum allowances for overall building power allowance

144

## Interior Lighting Power Requirements Additional Retail Allowance

COMMERCIAL  
Power & Lighting

New in  
2009 IECC

505.5.2

### Footnote to Table 505.5.2



### Use-it-or-lose-it allowance

b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = 1000 watts + (Retail Area 1 × 0.6 W/ft<sup>2</sup>) + (Retail Area 2 × 0.6W/ft<sup>2</sup>) + (Retail Area 3 × 1.4 W/ft<sup>2</sup>) + (Retail Area 4 × 2.5 W/ft<sup>2</sup>).

where:

Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4.

Retail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.

Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.

Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.

**Exception:** Other merchandise categories are permitted to be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is *approved* by the authority having jurisdiction.

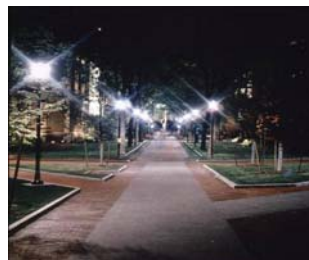
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## Exterior Lighting (Mandatory)

COMMERCIAL  
Power & Lighting

505.6

- Covered when power is supplied through building service
  - Efficient sources (505.6.1)
  - Maximum lighting power (505.6.2)
- Exceptions:
  - Low-voltage landscape lighting
  - “Where approved because of historical, safety, signage or emergency considerations”



Source: [www.energycodes.gov](http://www.energycodes.gov)

146

## Exterior Lighting (Mandatory) Exterior Building Grounds Lighting

COMMERCIAL  
Power & Lighting

505.6.1

- Efficient lighting sources
  - If luminaire power > 100 watts
  - Then efficacy  $\geq$  60 lumens/watt
- Exceptions:
  - Motion sensor control
  - Other exempt lighting (per 505.6.2)



Source: www.energycodes.gov

**Typical options:**  
 Full-size fluorescent  
 Pulse-start metal halide  
 Ceramic metal halide  
 High pressure sodium  
 Low-pressure sodium

147

## Exterior Lighting (Mandatory) Exterior Building Lighting Power

COMMERCIAL  
Power & Lighting

505.6.2

### Exterior lighting zones

1. Base site allowance
2. Tradable surfaces
  - Sum allowance for all surfaces
3. Nontradable surfaces
  - Each surface comply separately

Some exceptions

TABLE 505.6.2(1)  
EXTERIOR LIGHTING ZONES

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
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

New in  
2009 IECC

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## Exterior Lighting (Mandatory) Exterior Building Lighting Power

COMMERCIAL  
Power & Lighting

505.6.2

### 1. Base site allowance

New in  
2009 IECC

Zone 1	500 W
Zone 2	600 W
Zone 3	750 W
Zone 4	1300 W

149

## Exterior Lighting (Mandatory) Tradable Surfaces

New in  
2009 IECC

COMMERCIAL  
Power & Lighting

505.6.2

	Zone 1	Zone 2	Zone 3	Zone 4
<b>Uncovered Parking Areas</b>				
Parking areas and drives	0.04 W/ft <sup>2</sup>	0.06 W/ft <sup>2</sup>	0.10 W/ft <sup>2</sup>	0.13 W/ft <sup>2</sup>
<b>Building Grounds</b>				
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 <sup>2</sup>	0.14 W/ft <sup>2</sup>	0.16 W/ft <sup>2</sup>	0.2 W/ft <sup>2</sup>
Stairways	0.75 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup>
Pedestrian tunnels	0.15 W/ft <sup>2</sup>	0.15 W/ft <sup>2</sup>	0.2 W/ft <sup>2</sup>	0.3 W/ft <sup>2</sup>
<b>Building Entrances and Exits</b>				
Main entries	20 W/linear foot of door width	20 W/linear foot of door width	30 W/linear foot of door width	30 W/linear foot of door width
Other doors	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width
Entry canopies	0.25 W/ft <sup>2</sup>	0.25 W/ft <sup>2</sup>	0.4 W/ft <sup>2</sup>	0.4 W/ft <sup>2</sup>
<b>Sales Canopies</b>				
Free-standing and attached	0.6 W/ft <sup>2</sup>	0.6 W/ft <sup>2</sup>	0.8 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup>
<b>Outdoor Sales</b>				
Open areas (including vehicle sales lots)	0.25 W/ft <sup>2</sup>	0.25 W/ft <sup>2</sup>	0.5 W/ft <sup>2</sup>	0.7 W/ft <sup>2</sup>
Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	10 W/linear foot	10 W/linear foot	30 W/linear foot

Tradable Surfaces  
(Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas may be traded.)

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## Exterior Lighting (Mandatory) Nontradable Surfaces

New in  
2009 IECC

COMMERCIAL  
Power & Lighting

505.6.2

		Zone 1	Zone 2	Zone 3	Zone 4
Nontradable Surfaces (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	Building facades	No allowance	0.1 W/ft <sup>2</sup> for each illuminated wall or surface or 2.5 W/linear foot for each illuminated wall or surface length	0.15 W/ft <sup>2</sup> for each illuminated wall or surface or 3.75 W/linear foot for each illuminated wall or surface length	0.2 W/ft <sup>2</sup> for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length
	Automated teller machines 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 <sup>2</sup> of covered and uncovered area	0.75 W/ft <sup>2</sup> of covered and uncovered area	0.75 W/ft <sup>2</sup> of covered and uncovered area	0.75 W/ft <sup>2</sup> of covered and uncovered area
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 W/ft <sup>2</sup> of covered and uncovered area	0.5 W/ft <sup>2</sup> of covered and uncovered area	0.5 W/ft <sup>2</sup> of covered and uncovered area	0.5 W/ft <sup>2</sup> of covered and uncovered area
	Drive-up windows/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

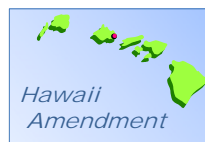
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## Electrical Energy Consumption (Mandatory)

COMMERCIAL  
Power & Lighting

505.7

*In new buildings with tenants, metering shall be collected for the entire building and individually for each tenant occupying 1,000 square feet (93 m<sup>2</sup>) or more. Tenants shall have access to all data collected for their space. A tenant is defined as "one who rents or leases from a landlord".*



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2009 IECC

## SECTION 506 TOTAL BUILDING PERFORMANCE

153

### Total Building Performance

COMMERCIAL  
Performance

506.

- When it's appropriate:
  - Window area > 40% of wall area
  - Window SHGC doesn't meet prescriptive requirement
  - Skylight area > 3% of roof area
  - Skylight performance doesn't meet prescriptive criteria
  - Lighting power exceeds prescriptive limit
  - Opaque constructions fail to meet prescriptive requirement
- Allows tradeoffs between HVAC, water heating and lighting energy

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# Total Building Performance

COMMERCIAL  
Performance

506.

## Computer simulation method

**Proposed Design  
Energy Cost**

≤

**Standard Reference Design  
Energy Cost**



As designed performance



- Hourly, full-year simulation
- DOE2, eQUEST, EnergyPlus, Trace, etc.

- Specifications per Section 506.5.1
- HVAC system type specified
  - Glazing limited to 40% wall area
  - Skylights limited to 3% roof area
  - Lighting power per Table 505.5.2
  - Mass wall if proposed is mass, otherwise steel-framed
  - Etc...

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2009 IECC

**COMCHECK  
COMPLIANCE SOFTWARE**

156



## COMcheck Compliance Software

- Two versions
  - Desktop
  - Web interface
- Envelope and lighting comply separately
  - Tradeoffs between not permitted
- Produces mechanical requirements checklist
- Does not implement Total Building Performance calculation



157

The screenshot displays the COMcheck-Web software interface in a Google Chrome browser window. The URL is <https://energycode.pnl.gov/COMcheckWeb/index.html>. The page title is "COMcheck-Web". The main content area is titled "Hawaii training - commercial" and "2009 IECC". The interface includes a navigation menu with tabs for "PROJECT", "ENVELOPE", "INT. LIGHTING", "EXT. LIGHTING", and "MECHANICAL".

**Code/Location**

Code: 2009 IECC  
State: Hawaii  
City: Hilo

**Project Type**

New Construction  Addition  Alterations

**Project Details (optional)**

This information will appear on the compliance report. [Edit Project Details...](#)

Notes:

**Building Use**

Area Category	Area Description	Quantity
1 Office		10

Total Area: 10000

**Exterior Lighting Areas**

Zone: Light industrial area with limited nighttime use

Exterior Lighting Area	Area Description	Quantity	W/Unit
1 Parking area	Front parking lot	5000 ft <sup>2</sup>	0.06

**Compliance Results:**

- Envelope Passes +0.22%
- Interior Lighting Passes +34%
- Exterior Lighting Passes +40%

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COMcheck-Web - Google Chrome  
 https://energycode.pnl.gov/COMcheckWeb/index.html

Hawaii training - commercial  
 2009 IECC

Envelope | INT. LIGHTING | EXT. LIGHTING | MECHANICAL

Row: Edit Duplicate Move Up Move Down Delete

Add: Roof Skylight Ext. Wall Window Door Basement Floor

Component	Assembly	Construction Details	Gross Area or Slab Perimeter	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor
1	Roof	Insulation Entirely Above Deck	10000 ft <sup>2</sup>		20.0	0.048		
2	Ext. Wall	Steel-Framed, 16in. o.c.	3000 ft <sup>2</sup>	19.0	0.0	0.110		
3	Window	Metal Frame, Single Pane Glazing: Tinted	1000 ft <sup>2</sup>			1.200	0.57	0.50
4	Floor	Unheated Slab-On-Grade	400 ft		0.0			

Envelope Passes +0.22% Interior Lighting Passes +34% Exterior Lighting Passes +40%

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COMcheck-Web - Google Chrome  
 https://energycode.pnl.gov/COMcheckWeb/index.html

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Envelope | INT. LIGHTING | EXT. LIGHTING | MECHANICAL

Row: Edit Duplicate Move Up Move Down Delete

Add: Linear Fluorescent Compact Fluorescent HID Incandescent Halogen Track Lighting

Options: Exemptions and Allowances

Component	Fixture ID	Fixture Description	Lamp Description / Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage
1		Office (10000 ft <sup>2</sup> )	Allowed wattage = 10000W Proposed wattage = 6600W				
2		Linear Fluorescent	48 in. T8 30W Super ...	Electronic	2	120	55
<b>Interior Lighting Totals:</b>			Allowed wattage = 10000 Proposed wattage = 6600				

Envelope Passes +0.22% Interior Lighting Passes +34% Exterior Lighting Passes +40%

Interior Lighting Passes. Design 34% better than Code

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COMcheck-Web - Google Chrome  
 https://energycode.pnl.gov/COMcheckWeb/index.html

**COMcheck-Web™**  
 2009 IECC

Hawaii training - commercial

Email Address Password Log In  
 Register | Forgot Password?  
 Create and save a copy of the currently loaded project

New Project PROJECT ENVELOPE INT. LIGHTING EXT. LIGHTING MECHANICAL Reports

Row: Edit Duplicate Move Up Move Down Delete Options: Exemptions

Add: Linear Fluorescent Compact Fluorescent HID Incandescent Halogen

	Component	Fixture ID	Fixture Description	Lamp Description / Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage
1	Front parking lot (Parking area, 5000 ft <sup>2</sup> )							
		Non-tradable Wattage: Allowed = 0W Proposed = 540W						
2	HID			Metal Halide 150W	Pulse Start	1	3	180
		Tradable Wattage Totals: Allowed = 0 Proposed = 0		Supplemental Wattage: 600W				

Envelope Passes +0.22%
  Interior Lighting Passes +34%
  Exterior Lighting Passes +40%

Exterior Lighting: Passes using supplemental allowance watts. Design 40% better than Code

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2009 IECC

# COMMERCIAL COMPLIANCE CHECKLIST

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# Commercial Compliance Checklists

- Design checklist
- Plan review checklist

IECC 2009 with Hawaii Amendments					
COMMERCIAL PLAN REVIEW CHECKLIST					
Project: _____					
Code Section	Description	Documentation Requirement	Yes	Complete	
<b>GENERAL REQUIREMENTS</b>					
103.1	Construction documents	Signed statement on plans	<input type="checkbox"/>	<input type="checkbox"/>	plans
<b>ENVELOPE REQUIREMENTS</b>					
102.1	Roof - insulation entirely above deck Roof - metal building Roof - attic or office Table 102.2(1) insulation R-value Table 102.2.1 U-factor 102.2.1.1 Cool-roof exception	Insulation location and R-value indicated on plans. Cool-roof specifications if applicable.	<input type="checkbox"/>	<input type="checkbox"/>	plans attic
102.1	Wall - masonry Wall - metal building Wall - wood framed Table 102.2(1) insulation R-value Table 102.2.1 U-factor	Insulation location and R-value indicated on plans.	<input type="checkbox"/>	<input type="checkbox"/>	plans, if
102.3.1	Windows - maximum area 10% of gross wall area		<input type="checkbox"/>	<input type="checkbox"/>	plans
102.3.2	Windows - solar heat gain SHGC 0.30 if projection factor < 0.20 SHGC 0.35 if projection factor 0.25-0.50 SHGC 0.40 if projection factor > 0.50 Area-weighted average	SHGC indicated on plans. Overhang dimensions on plans, if applicable.	<input type="checkbox"/>	<input type="checkbox"/>	plans
102.3.1	Skylights - maximum area 2% of gross roof area		<input type="checkbox"/>	<input type="checkbox"/>	plans
102.3.2	Skylights - solar heat gain SHGC 0.30 Area-weighted average	SHGC indicated on plans.	<input type="checkbox"/>	<input type="checkbox"/>	indicated on
102.3.2	Skylights - U-factor U-factor 0.75	U-factor indicated on plans.	<input type="checkbox"/>	<input type="checkbox"/>	
102.4	Air leakage 102.4.1 Windows and door assemblies 102.4.2 Curtain wall, storefront glazing and commercial entrance doors 102.4.3 Sealing of the building envelope 102.4.4 Outdoor air intakes and exhaust openings 102.4.6 Loading dock seals/doors 102.4.8 Recirculated lighting	Sealing requirements indicated on plans, if applicable.	<input type="checkbox"/>	<input type="checkbox"/>	

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2009 IECC  
WRAP UP

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## Resources

- From ICC ([www.iccsafe.org](http://www.iccsafe.org))
  - 2009 IECC
  - 2009 IECC & commentary
  - 2009 IECC & ASHRAE Std 90.1-2007
- [www.energycodes.gov](http://www.energycodes.gov)
  - Building Energy Codes University
  - Presentations, videos, other resources
  - REScheck, COMcheck
- DBEDT Resources
  - <http://energy.hawaii.gov/resources/hawaii-state-energy-office-publications>
  - Includes *Hawaii Homeowner's Guide to Energy, Comfort & Value*
- Hawaii Commercial Building Guide for Energy Efficiency
  - At: [www.kolderupconsulting.com/resources](http://www.kolderupconsulting.com/resources)

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The screenshot shows a YouTube video player interface. The video title is "COMcheck Basics" and it is from the "Building Energy Codes Program" channel. The video features Rose Bartlett and Pam Cole. The video player shows a progress bar at 0:00:02 / 1:45:11. To the right of the video player, there is a "Favorites (4)" section with a list of related videos:

- COMcheck Basics (EnergyCodes - 1,223 views) - 1:45:11
- REScheck Basics (EnergyCodes - 2,177 views) - 1:08:33
- Residential Requirements of the EnergyCodes - 1,985 views - 1:09:37
- Residential Plan Review (3) - see all
- Residential Pre-Inspection & Plan EnergyCodes - 475 views - 2:26
- Air Duct System EnergyCodes - 1,385 views - 0:23

At the bottom of the video player, there are buttons for "Info", "Favorite", "Share", "Playlists", and "Flag". Below the video player, there is a "COMcheck Basics" title and a "Like" button.

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## Questions?

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