BUILDING ENERGY CODES

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Overview of the 2012 IECC and DOE's Involvement

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The World of Codes

- 1980's through 2006
  - Minimum codes were truly minimal
  - DOE pushed for marginal improvements (1% to 3% per cycle)
  - DOE proposed (successfully) a major rewrite of the IECC in 2004 (became the 2006 IECC)—emphasis was format, not stringency
- 2009 to Present…..
  - Things are getting more serious

2012 IECC Overview – Major Changes

- Summary of changes
  - ~30% better than 2006 IECC
  - Major changes
    - Consolidated with IRC energy chapter (actually a change to the IRC, not the IECC)
    - Mandatory whole-house pressure test
    - More stringent duct leakage test
    - DHW distribution system requirements
  - Minor changes
  - Key non-changes
    - Retains prohibition on envelope-equipment trade-offs
    - Makes lighting requirements “mandatory”

Structure of the 2012 IECC

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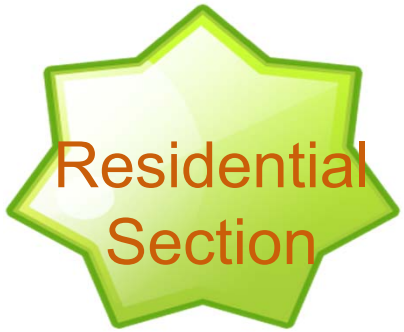

Ch. 1 Scope and Application / Administrative and Enforcement
Ch. 2 Definitions
Ch. 3 General Requirements
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Ch. 1 Scope and Application / Administrative and Enforcement
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Ch. 5 Referenced Standards
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Exceptions

- ✓ Storm windows over existing fenestration
- ✓ Glass-only replacements
- ✓ Exposed, existing ceiling, wall or floor cavities if already filled with insulation
- ✓ Where existing roof, wall or floor cavity isn't exposed
- ✓ 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)

Insulation and Fenestration Requirements by Climate Zone

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TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

Requirements by Climate Zone

U-Factor Table

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TABLE R402.1.3
EQUIVALENT *U*-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

2012 IECC – Major Prescriptive Envelope Changes

Zone	Ceiling R-Value
1	
2	R30 → R38
3	
4 except Marine	R38 → R49
5 and Marine 4	
6	
7 & 8	

Eave Baffle

Section R402.2.3

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For air permeable insulations in vented attics, baffle

- ✓ Installed adjacent to soffit and eave vents
- ✓ To maintain an opening ≥ size of vent
- ✓ To extend over top of attic insulation
- ✓ May be of any solid material

2012 IECC – Major Prescriptive Envelope Changes

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Zone	Wood-Frame Wall R-Value	Mass Wall R-Value
1		
2		
3	R13 → R20/R13+5	R5/8 → R8/13
4 except Marine		
5 and Marine 4		
6	R20/R13+5 → R20+5/R13+10	R15/19 → R15/20
7 & 8	R21 → R20+5/R13+10	

Implications of Wall Improvements

- 2x6 construction now “required” in some zones
  - Envelope trade-off options limited
  - Equipment trade-off options prohibited
- Log walls difficult to comply without large diameter logs or furred-in finish layer
- Insulating sheathing now “required” in some zones
  - Bracing options limited, especially with recent IRC changes

2012 IECC – Major Prescriptive Envelope Changes

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Zone	Basement Wall R-Value	Crawlspace Wall R-Value
1		
2		
3		
4 except Marine		
5 and Marine 4	R10/13 → R15/19	R10/13 → R15/19
6		
7 & 8		

2012 IECC – Major Prescriptive Envelope Changes

Zone	Fenestration U-Factor	Fenestration SHGC
1	1.2 → 0.50	0.30 → 0.25 (except skylights)
2	0.65 → 0.40 (0.75 → 0.65 skylights)	
3	0.50 → 0.35 (0.65 → 0.55 skylights)	
4 except Marine	(0.60 → 0.55 skylights)	NR → 0.40
5 and Marine 4	0.35 → 0.32 (0.60 → 0.55 skylights)	
6		
7 & 8		

Air Leakage Control
Section R402.4.1

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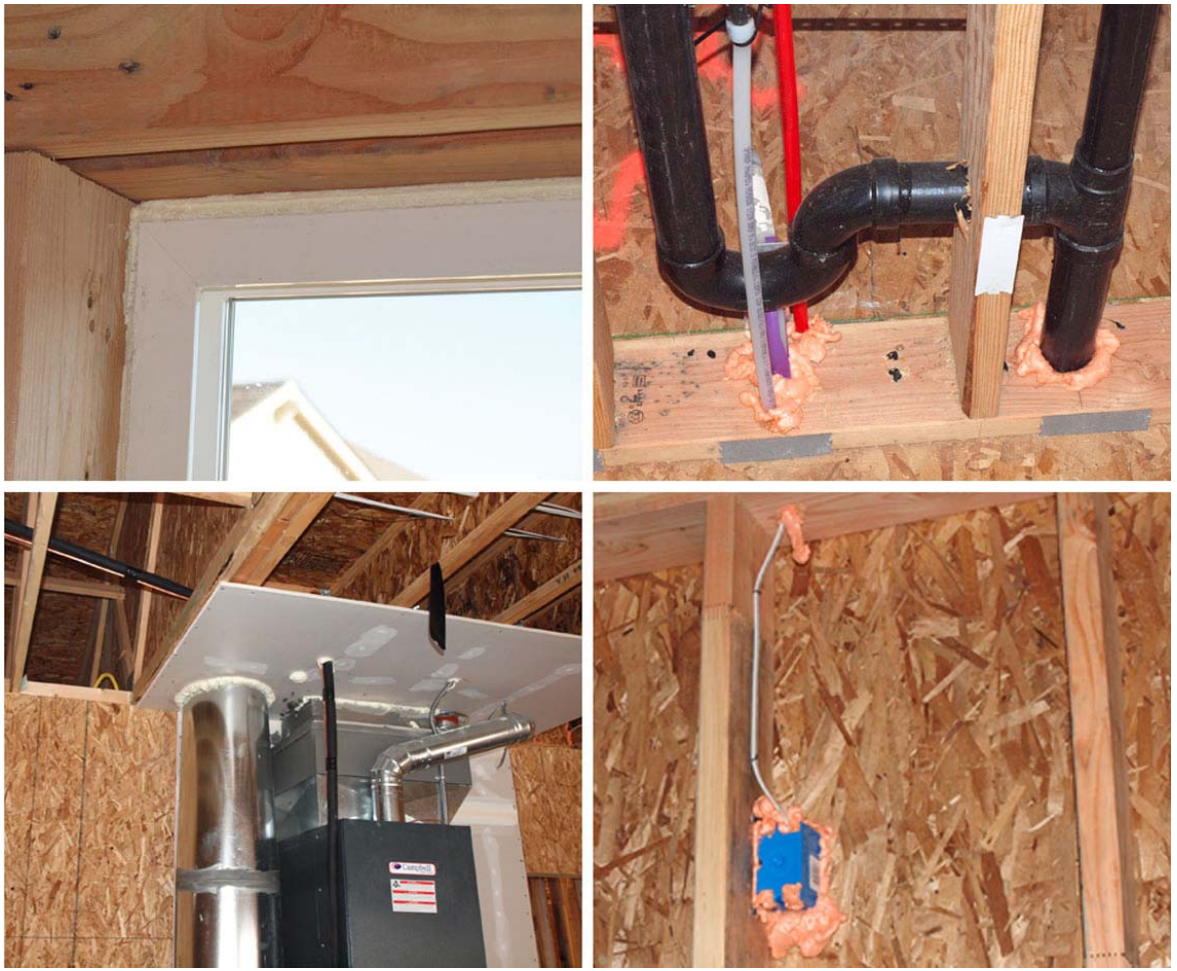
Building thermal envelope



Two requirement to demonstrate compliance (not options)

✓ Whole-house pressure test

Air Leakage Rate	Climate Zone	Test Pressure
≤ 5 ACH	1-2	50 Pascals
≤ 3 ACH	3-8	50 Pascals

- Testing may occur any time after creation of all building envelope penetrations

✓ Field verification of items listed in Table R402.4.1.1

Building Thermal Envelope

Section R402.4.1 – Air Leakage

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TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	CRITERIA[a]
Air barrier and thermal barrier	A continuous air barrier shall be installed in the building envelope. Exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed. Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.
Walls	Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.
Rim joists	Rim joists shall be insulated and include the air barrier.
Floors (including above-garage and cantilevered floors)	Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.
Crawl space walls	Where provided in lieu of floor insulation, insulation shall be permanently attached to the crawlspace walls. Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.
Narrow cavities	Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated, and sealed to the drywall.
Plumbing and wiring	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	Exterior walls adjacent to showers and tubs shall be insulated and the air barrier installed separating them from the showers and tubs.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the sub-floor or drywall.
Fireplace	An air barrier shall be installed on fireplace walls. Fireplaces shall have gasketed doors.

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Duct Tightness Tests
Section R403.2.2

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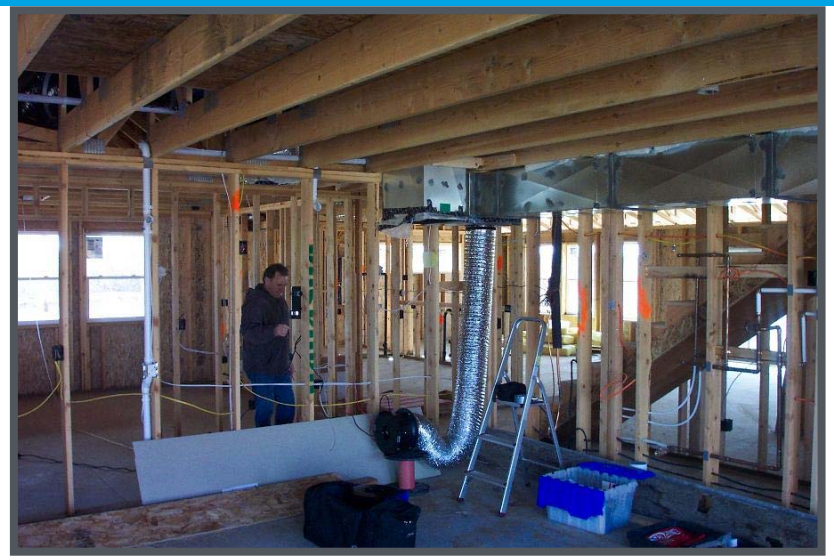

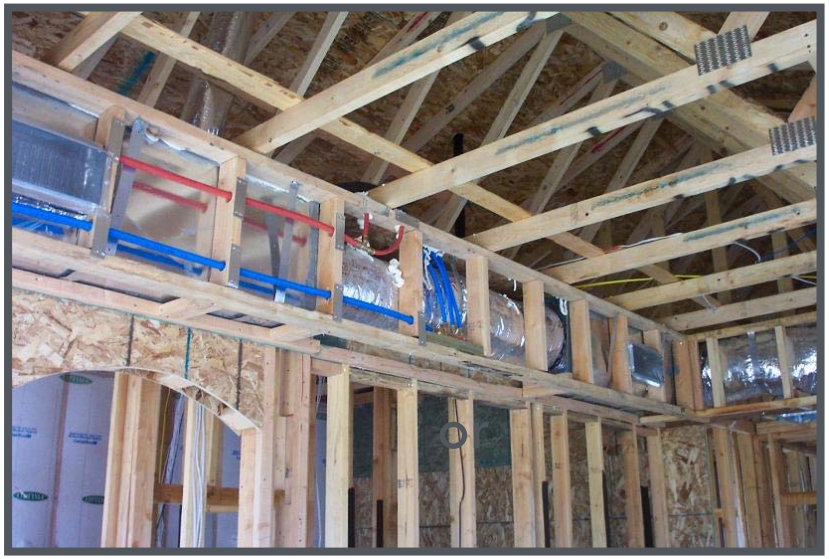

Duct leakage rates lowered

- Eliminated “leakage to outdoors” option
- From 12 to 4 CFM/100sf CFA (after construction)
- From 6 to 4 CFM/100sf CFA (at rough-in)

Sealed Air Handler

Section R403.2.2.1

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Air handlers to have a manufacturer's designation for an air leakage of ≤ 2% of design air flow rate per ASHRAE 193

Building Cavities
Section R403.2.3 - Mandatory

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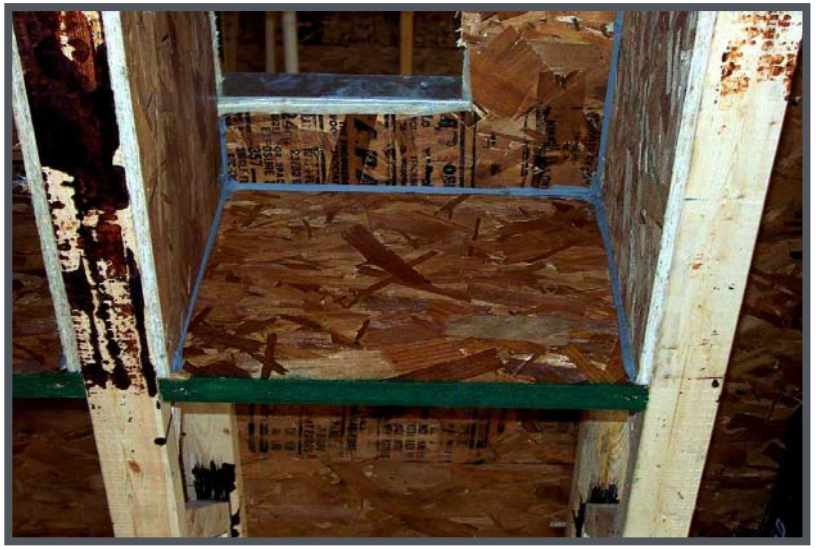
Framing cavities cannot be used as ducts or plenums



Piping Insulation

Section R403.3 - Mandatory

- ✓ R-3 required on
  - HVAC systems
    - Exception: Piping that conveys fluids between 55 and 105° F
- If exposed to weather,
  - protect from damage, including
    - Sunlight
    - Moisture
    - Equipment maintenance
    - Wind
  - Provide shielding from solar radiation that can cause degradation of material
  - Adhesive tape is not allowed

Piping Insulation
Section R403.3

- R-3 required on
  - Piping > ¾ in. nominal diameter
  - Piping serving more than one dwelling unit
  - Piping from the water heater to kitchen outlets
  - Piping located outside the conditioned space
  - Piping from the water heater to a distribution manifold
  - Piping under a floor slab
  - Buried piping
  - Supply and return piping in recirculating systems other than demand recirculation systems
  - Piping with run lengths > maximum run lengths for nominal pipe diameter in Table R403.4.2
- All remaining piping to be at least R-3 or meet run length requirements in Table R403.4.2

Piping Insulation

Section R403.3

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TABLE R403.4.2
MAXIMUM RUN LENGTH (feet)[a]

Nominal Pipe Diameter of Largest Diameter Pipe in the Run (inch)	3/8	1/2	3/4	> 3/4
Maximum Run Length	30	20	10	5

For SI: 1 inch = 25.4 mm, 1 foot 304.8 mm.

a. Total length of all piping from the distribution manifold or the recirculation loop to a point of use.

Mechanical Ventilation
Section R403.5 / Mandatory

- ✓ Ventilation
  - – Building to have ventilation meeting IRC or IMC or with other approved means
  - – Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating
- ✓ Whole-house mechanical ventilation system fans to meet efficacy in Table R403.5.1
  - ✓ **Exception**
    - ✓ When fans are integral to tested and listed HVAC equipment, powered by electronically commutated motor

TABLE R403.5.1
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

For SI: 1 cfm = 28.3 L/min.

Equipment Sizing
Section R403.6

- ✓ Equipment Sizing
  - IECC references Section M1401.3 of the IRC
  - Load calculations determine the proper capacity (size) of equipment
    - Goal is big enough to ensure comfort but no bigger
  - Calculations shall be performed in accordance with ACCA Manual J & S or other approved methods

Lighting Equipment

Section R404.1 - Prescriptive

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

Exception:

- ✓ Low-voltage lighting