

# ASHRAE

STANDARD 90.1-2013

## THINGS YOU SHOULD KNOW

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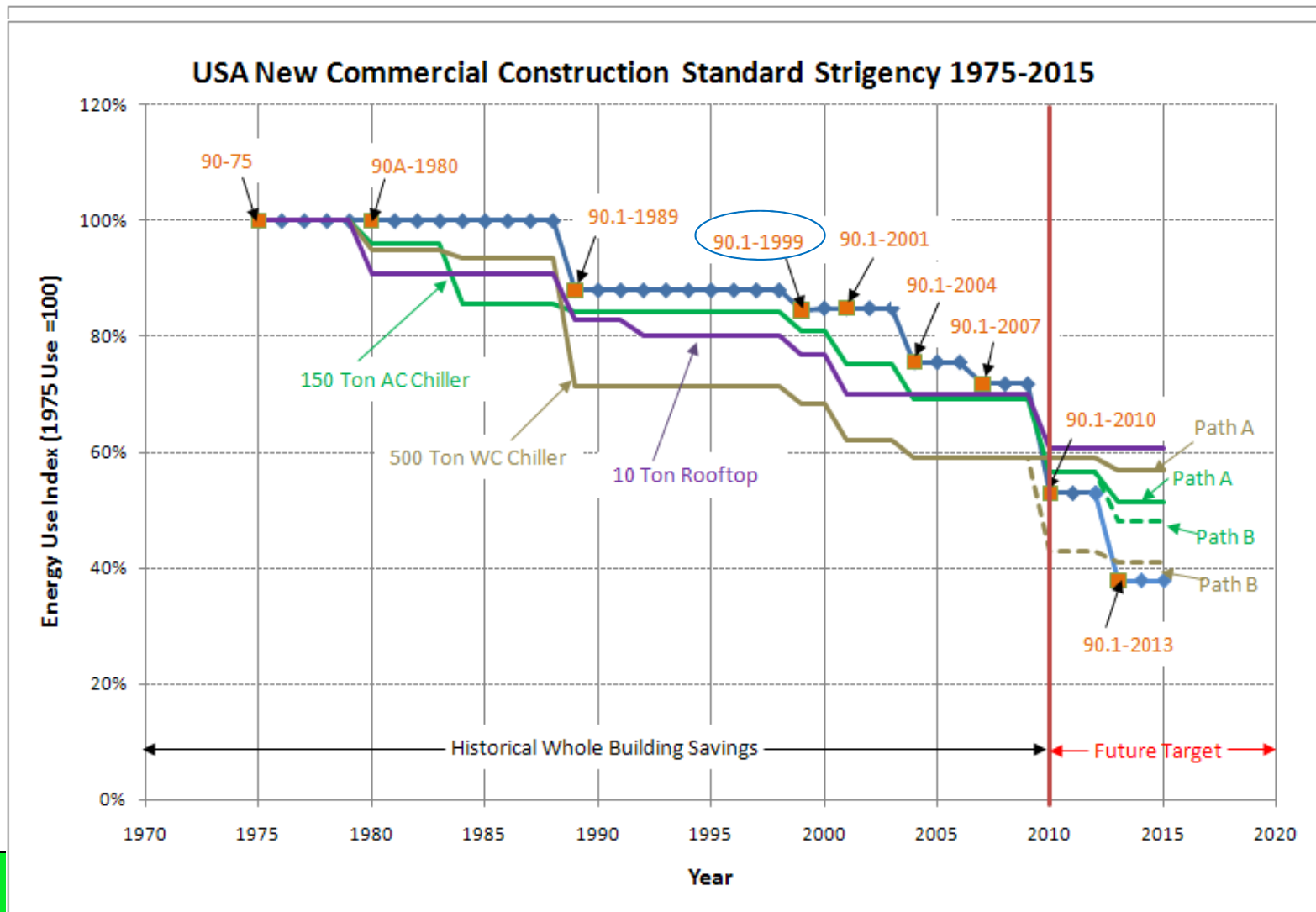
# Standard 90.1 Committee, Denver 2013



46 voting members

# Historical Efficiency Improvements

Significant progress has been made in improving the energy efficiency of buildings and HVAC equipment



# First-Cost DOE 90.1-2013

TABLE 2—INCREMENTAL CONSTRUCTION FIRST COST (2013\$) FOR ASHRAE 90.1–2013 vs. ASHRAE 90.1–2010

Prototype	Value	ASHRAE Climate zone				
		2A	3A	3B	4A	5A
Small Office .....	First Cost .....	(\$2,601)	(\$906)	(\$1,358)	\$12,472	\$9,072
	\$/ft2 .....	(\$0.47)	(\$0.16)	(\$0.25)	\$2.27	\$1.65
Large Office .....	First Cost .....	\$352,647	(\$1,065,759)	(\$1,476,190)	\$98,124	(\$1,014,770)
	\$/ft2 .....	\$0.71	(\$2.14)	(\$2.96)	\$0.20	(\$2.04)
Primary School .....	First Cost .....	\$88,857	\$119,646	\$9,620	\$167,916	\$179,872
	\$/ft2 .....	\$1.20	\$1.62	\$0.13	\$2.27	\$2.43
Small Hotel .....	First Cost .....	\$20,483	\$18,527	\$18,675	\$32,441	\$39,120
	\$/ft2 .....	\$0.47	\$0.43	\$0.43	\$0.75	\$0.91
Mid-rise Apartment .....	First Cost .....	\$5,711	\$23,214	\$23,358	\$12,891	\$19,577
	\$/ft2 .....	\$0.17	\$0.69	\$0.69	\$0.38	\$0.58

**1. Notes:** Negative costs (shown in parentheses) indicate a reduction in cost due to changes in the code, usually due to reduced HVAC capacity.<sup>12</sup>

# Savings DOE 90.1-2013

TABLE 4—ANNUAL LIFE-CYCLE COST (LCC) NET SAVINGS (2013\$) FOR ASHRAE 90.1–2013 VS. ASHRAE 90.1–2010

Prototype		ASHRAE Climate zone				
	Value	2A	3A	3B	4A	5A
Small Office .....	Total .....	\$21,600.00	\$15,200.00	\$10,800.00	\$2,900.00	\$5,000.00
	\$/ft <sup>2</sup> .....	3.93	2.76	1.96	0.51	0.91
Large Office .....	Total .....	740,000.00	1,650,000.00	2,540,000.00	310,000.00	1,340,000.00
	\$/ft <sup>2</sup> .....	1.48	3.31	5.09	0.60	2.69
Primary School .....	Total .....	246,000.00	116,000.00	398,000.00	70,000.00	109,000.00
	\$/ft <sup>2</sup> .....	3.33	1.57	5.38	0.95	1.47
Small Hotel .....	Total .....	96,410.00	76,000.00	78,000.00	62,600.00	68,000.00
	\$/ft <sup>2</sup> .....	2.23	1.76	1.81	1.45	1.57
Mid-rise Apartment .....	Total .....	59,600.00	22,600.00	23,800.00	29,200.00	28,500.00
	\$/ft <sup>2</sup> .....	1.77	0.67	0.71	0.87	0.84

<https://www.federalregister.gov/articles/2015/11/06/2015-28078/energy-efficiency-standards-for-new-federal-commercial-and-multi-family-high-rise-residential#t-2>

2013

# LIGHTING POWER TABLES

# Space-by-Space Method

**Table 9.6.1, Part 1** TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:

- (1) All REQs shall be implemented.
- (2) At least one ADD1 (when present) shall be implemented.
- (3) At least one ADD2 (when present) shall be implemented.

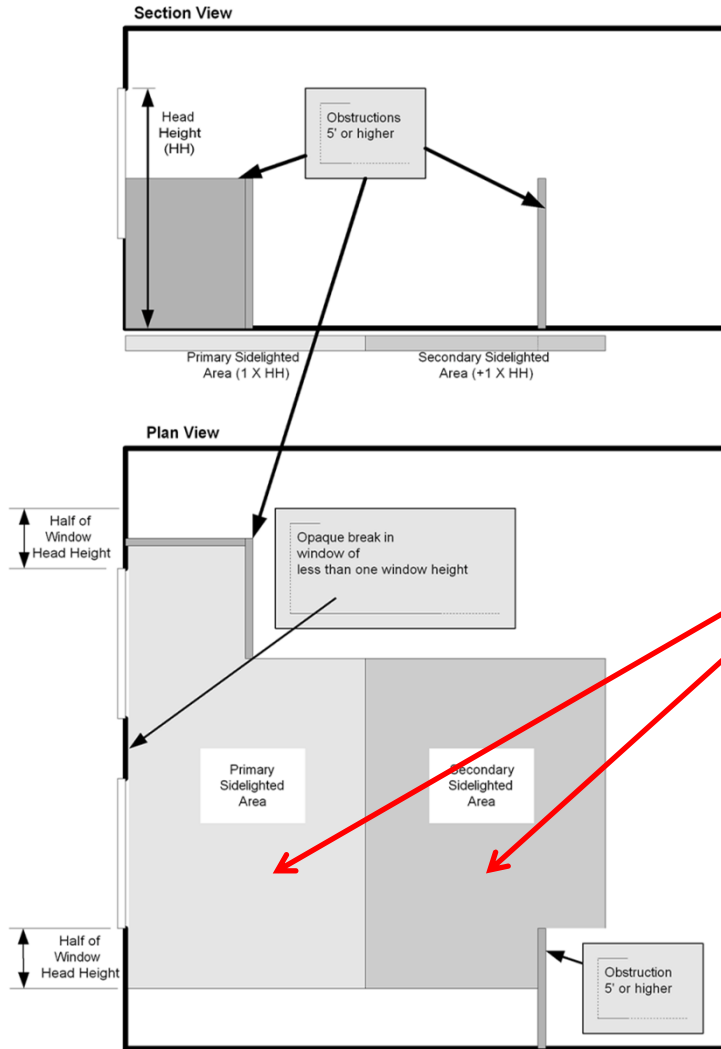
*Informative Note:* This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.

Common Space Types <sup>1</sup>	LPD, W/ft <sup>2</sup>	RCR Threshold	Local Control (See Section 9.4.1.1[a])	Restricted to Manual ON (See Section 9.4.1.1[b])	Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	Bilevel Lighting Control (See Section 9.4.1.1[d])	Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e] <sup>6</sup> )	Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f] <sup>6</sup> )	Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	Automatic Full OFF (See Section 9.4.1.1[h])	Scheduled Shutoff (See Section 9.4.1.1[i])
			a	b	c	d	e	f	g	h	i
<b>Atrium</b>											
... that is <20 ft in height	0.03/ft total height	NA	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
... that is ≥20 ft and ≤40 ft in height	0.03/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... that is >40 ft in height	0.40 + 0.02/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
<b>Audience Seating Area</b>											
... in an auditorium	0.63	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a convention center	0.82	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a gymnasium	0.65	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a motion picture theater	1.14	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a penitentiary	0.28	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
... in a performing arts theater	2.43	8	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a religious building	1.53	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a sports arena	0.43	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
... all other audience seating areas	0.43	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
<b>Banking Activity Area</b>	1.01	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
<b>Breakroom (See Lounge/Breakroom)</b>											
<b>Classroom/Lecture Hall/Training Room</b>											
... in a penitentiary	1.34	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
... all other classrooms/lecture halls/ training rooms	1.24	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—



## 9.4.1.1 INTERIOR LIGHTING CONTROLS

### e. Automatic daylight responsive controls for sidelighting



In any space where the combined input power of all general lighting completely or partially within the primary and secondary sidelighted areas is 300 W or greater, the general lighting in the *primary sidelighted areas and secondary sidelighted areas* shall be controlled by photocontrols.

## 9.4.1.2

# Parking Garage Lighting Control (1)

- a. Parking garage shall have automatic lighting shutoff per Section 9.4.1.1(i)
  - (Scheduled shutoff).
  
- b. Lighting power for each luminaire shall automatically be reduced by 30% when no activity detected in lighting zone for 20 minutes.
  - Maximum zone size here is 3600 ft<sup>2</sup>.
  - Exempt: Daylight transition zones and ramps without parking

## 9.4.1.2

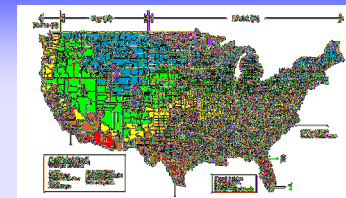
# Parking Garage Lighting Control (2)

- c. Lighting for covered vehicle entrances and exits from buildings and parking structures:
  - Shall be separately controlled by device
  - Automatically reduce lighting by 50% or more
  - From sunset to sunrise
  
- d. Daylight control: Power to luminaires within 20 ft of any perimeter wall structure shall be automatically reduced in response to daylighting, if:
  - There is a net opening-to-wall ratio of at least 40%
  - And there are no exterior obstructions within 20 ft.

2013

# **ENVELOPE IMPROVEMENT**

# Opaque Stringency Increases From 2004 to 2013 - *Roofs*

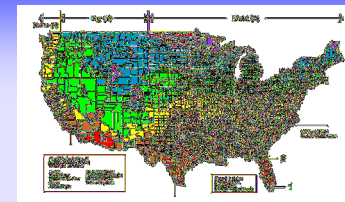


## Building Opaque Envelope Nonresidential Insulation Minimum R-Value Requirements

### Climate Zones (CZ)

<b>Roofs</b>		<b>CZ 1</b>	<b>CZ 2</b>	<b>CZ 3</b>	<b>CZ 4</b>	<b>CZ 5</b>	<b>CZ 6</b>	<b>CZ 7</b>	<b>CZ 8</b>
<b>Insulation Entirely above Deck</b>	<b>90.1-2004</b>	R-15.0 ci	R-15.0 ci	R-15.0 ci	R-15.0 ci	R-15.0 ci	R-15.0 ci	R-15.0 ci	R-20.0 ci
	<b>90.1-2007</b>	R-15.0 ci	<b>R-20.0 ci</b>	<b>R-20.0 ci</b>	<b>R-20.0 ci</b>	<b>R-20.0 ci</b>	<b>R-20.0 ci</b>	<b>R-20.0 ci</b>	<b>R-20.0 ci</b>
	<b>90.1-2010</b>	R-15.0 ci	R-20.0 ci	R-20.0 ci	R-20.0 ci	R-20.0 ci	R-20.0 ci	R-20.0 ci	R-20.0 ci
	<b>90.1-2013</b>	<b>R-20.0 ci</b>	<b>R-25.0 ci</b>	<b>R-25.0 ci</b>	<b>R-30.0 ci</b>	<b>R-30.0 ci</b>	<b>R-30.0 ci</b>	<b>R-35.0 ci</b>	<b>R-35.0 ci</b>
<b>Metal Building</b>	<b>90.1-2004</b>	R-19.0	R-19.0	R-19.0	R-19.0	R-19.0	R-19.0	R-19.0	R-13.0 + R-19.0
	<b>90.1-2007</b>	R-19.0	R-19.0	R-19.0	R-19.0	R-19.0	R-19.0	R-19.0	R-13.0 + R-19.0
	<b>90.1-2010</b>	R-19.0	<b>R-13.0 + R-13.0</b>	<b>R-13.0 + R-13.0</b>	<b>R-13.0 + R-13.0</b>	<b>R-13.0 + R-13.0</b>	<b>R-13.0 + R-19.0</b>	<b>R-13.0 + R-19.0</b>	<b>R-13.0 + R-19.0 Ls</b>
	<b>90.1-2013</b>	<b>R-10.0 + R-19 FC</b>	<b>R-10.0 + R-19 FC</b>	<b>R-10.0 + R-19 FC</b>	<b>R-19 + R-11 Ls or R-25 + R-8 Ls</b>	<b>R-19 + R-11 Ls or R-25 + R-8 Ls</b>	<b>R-25 + R-11 Ls</b>	<b>R-30 + R-11 Ls</b>	<b>R-25 + R-11 + R-11 Ls</b>
<b>Attic and Other</b>	<b>90.1-2004</b>	R-30.0	R-30.0	R-30.0	R-30.0	R-30.0	R-38.0	R-38.0	R-38.0
	<b>90.1-2007</b>	R-30.0	<b>R-38.0</b>	<b>R-38.0</b>	<b>R-38.0</b>	<b>R-38.0</b>	R-38.0	R-38.0	<b>R-49.0</b>
	<b>90.1-2010</b>	R-30.0	R-38.0	R-38.0	R-38.0	R-38.0	R-38.0	R-38.0	R-49.0
	<b>90.1-2013</b>	<b>R-38.0</b>	R-38.0	R-38.0	<b>R-49.0</b>	<b>R-49.0</b>	<b>R-49.0</b>	<b>R-60.0</b>	<b>R-60.0</b>

# Opaque Stringency Increases From 2004 to 2013 - Walls

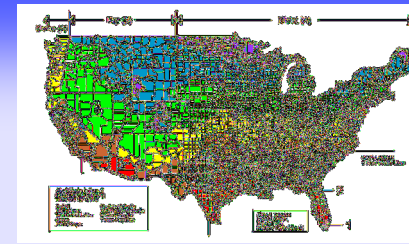


## Building Opaque Envelope Nonresidential Insulation Minimum R-Value Requirements

Climate Zones (CZ)

<i>Walls, Above Grade</i>		CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
<b>Mass</b>	90.1-2004	NR	NR	R-5.7 ci <sup>a, b</sup>	R-5.7 ci <sup>a, b</sup>	R-7.6 ci	R-9.5 ci	R-11.4 ci	R-13.3 ci
	90.1-2007	NR	R-5.7 ci <sup>a, b</sup>	R-7.6 ci	R-9.5 ci	R-11.4 ci	R-13.3 ci	R-15.2 ci	R-15.2 ci
	90.1-2010	NR	R-5.7 ci <sup>a, b</sup>	R-7.6 ci	R-9.5 ci	R-11.4 ci	R-13.3 ci	R-15.2 ci	R-15.2 ci
	90.1-2013	NR	R-5.7 ci <sup>a, b</sup>	R-7.6 ci	R-9.5 ci	R-11.4 ci	R-13.3 ci	R-15.2 ci	<b>R-19.0 ci</b>
<b>Metal Building</b>	90.1-2004	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0 + R-13.0	R-13.0 + R-13.0
	90.1-2007	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0 + R-13.0	R-13.0 + R-13.0
	90.1-2010	<b>R-16.0</b>	<b>R-16.0</b>	<b>R-19.0</b>	<b>R-19.0</b>	<b>R-13.0 + R-5.6 c.i.</b>	<b>R-13.0 + R-5.6 c.i.</b>	<b>R-19.0 + R-5.6 c.i.</b>	<b>R-19.0 + R-5.6 c.i.</b>
	90.1-2013	<b>R-0 + R-9.8 c.i.</b>	<b>R-0 + R-9.8 c.i.</b>	<b>R-0 + R-9.8 c.i.</b>	<b>R-0 + R-15.8 c.i.</b>	<b>R-0 + R-19.0 c.i.</b>	<b>R-0 + R-19.0 c.i.</b>	<b>R-0 + R-22.0 c.i.</b>	<b>R-0 + R-25.0 c.i.</b>
<b>Steel Framed</b>	90.1-2004	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0 + R-3.8 ci	R-13.0 + R-3.8 ci	R-13.0 + R-7.5 ci	R-13.0 + R-7.5 ci
	90.1-2007	R-13.0	R-13.0	R-13.0 + R-3.8 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.
	90.1-2010	R-13.0	R-13.0	R-13.0 + R-3.8 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.
	90.1-2013	R-13.0	<b>R-13.0 + R-3.8 c.i.</b>	<b>R-13.0 + R-5.0 c.i.</b>	R-13.0 + R-7.5 c.i.	<b>R-13.0 + R-10.0 c.i.</b>	<b>R-13.0 + R-12.5 c.i.</b>	<b>R-13.0 + R-12.5 c.i.</b>	<b>R-13.0 + R-18.8 c.i.</b>
<b>Wood Framed and Other</b>	90.1-2004	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0 + R-7.5 ci
	90.1-2007	R-13.0	R-13.0	R-13.0	R-13.0	<b>R-13.0 + R-3.8 c.i.</b>	<b>R-13.0 + R-7.5 c.i.</b>	<b>R-13.0 + R-7.5 c.i.</b>	<b>R-13.0 + R-15.6 c.i.</b>
	90.1-2010	R-13.0	R-13.0	R-13.0	R-13.0	R-13.0 + R-3.8 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-15.6 c.i.
	90.1-2013	R-13.0	R-13.0	R-13.0	<b>R-13.0 + R-3.8 c.i.</b>	<b>R-13 + R-7.5 c.i. or R-19 + R-5 c.i.</b>	R-13 + R-7.5 c.i. or R-19 + R-5 c.i.	R-13 + R-7.5 c.i. or R-19 + R-5 c.i.	<b>R-13.0 + R-18.8 c.i.</b>

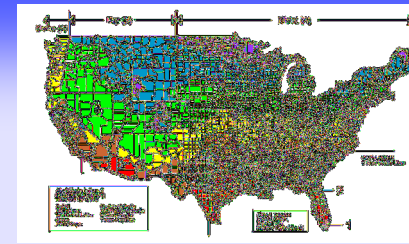
# Fenestration Prescriptive Req.: 90.1-2004 thru 90.1-2013



Vertical Fenestration, ≤ 40% of Wall		Max. U, of Fenestration Assembly								
		CZ 1	CZ 2	CZ 3	CZ 3C	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
90.1-2004	Fixed, all, ≤ 40%	1.2	1.2	0.6	1.22	0.6	0.6	0.6	0.6	0.5
	Fixed, north, ≤ 40%									
	Operable, all, ≤ 40%	1.3	1.3	0.7	1.27	0.7	0.7	0.7	0.7	0.5
	Operable, north, ≤ 40%									
90.1-2007	Nonmetal framing, all	1.20	0.75	0.65		0.40	0.35	0.35	0.35	0.35
	Metal framing, curtainwall etc.	1.20	0.70	0.60		0.50	0.45	0.45	0.40	0.40
	Metal framing, all other	1.20	0.75	0.65		0.55	0.55	0.55	0.45	0.45
	Metal framing, entrance door	1.20	1.10	0.90		0.85	0.80	0.80	0.80	0.80
90.1-2010	Nonmetal framing, all	1.20	0.75	0.65		0.40	0.35	0.35	0.35	0.35
	Metal framing, curtainwall etc.	1.20	0.70	0.60		0.50	0.45	0.45	0.40	0.40
	Metal framing, all other	1.20	0.75	0.65		0.55	0.55	0.55	0.45	0.45
	Metal framing, entrance door	1.20	1.10	0.90		0.85	0.80	0.80	0.80	0.80
90.1-2013	Nonmetal framing, all	0.5	0.4	0.35		0.35	0.32	0.32	0.32	0.32
	Metal framing, fixed	0.57	0.57	0.50		0.42	0.42	0.42	0.38	0.38
	Metal framing, operable	0.65	0.65	0.60		0.50	0.50	0.50	0.40	0.40
	Metal framing, entrance door	1.10	0.83	0.77		0.77	0.77	0.77	0.77	0.77

	Max. SHGC, of Fenestration Assembly								
	CZ 1	CZ 2	CZ 3	CZ 3C	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
All at 20%	0.25	0.25	0.25	0.39	0.39	0.39	0.39	0.49	NR
N at 20%	0.61	0.61	0.49	0.61	0.49	0.49	0.49	0.64	NR
All at 40%	0.25	0.25	0.25	0.34	0.39	0.39	0.39	0.49	NR
N at 40%	0.44	0.61	0.39	0.61	0.49	0.49	0.49	0.64	NR
	0.25	0.25	0.25		0.40	0.40	0.40	0.45	0.45
	0.25	0.25	0.25		0.40	0.40	0.40	0.45	0.45
	0.25	0.25	0.25		0.40	0.40	0.40	0.45	0.45

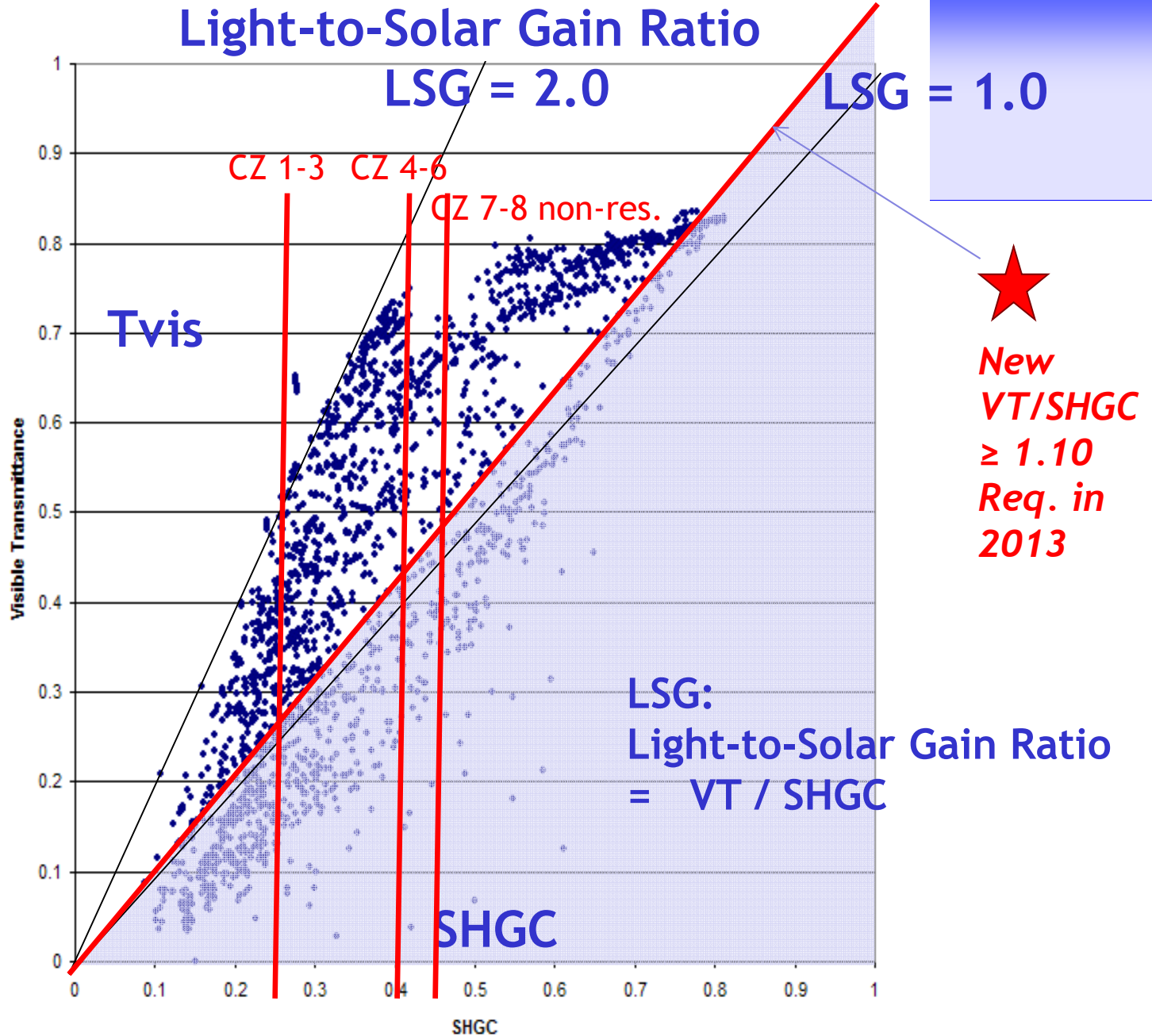
# Fenestration Prescriptive Req.: 90.1-2004 thru 90.1-2013



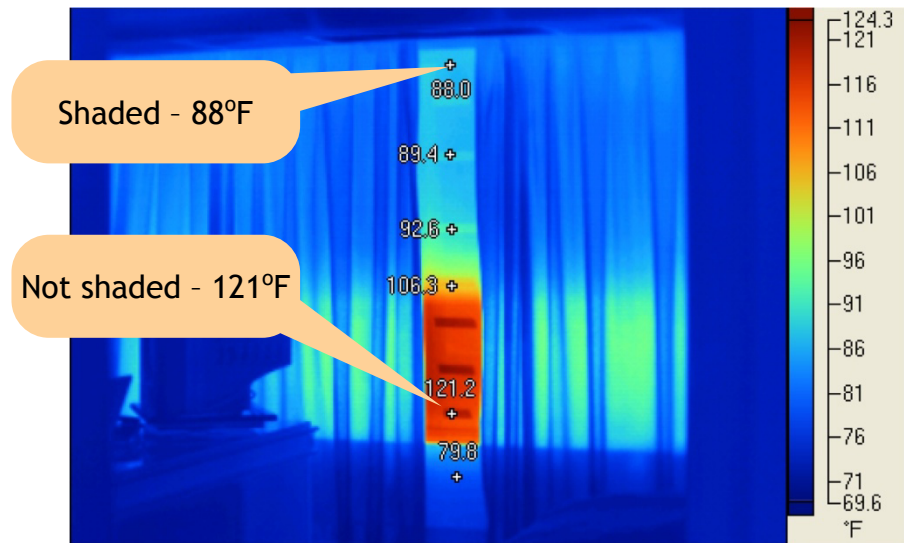
<i>Vertical Fenestration, ≤ 40% of Wall</i>		Min. VT/SHGC, of Fenestration Assembly							
		CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
90.1-2004	Fixed, all, ≤ 40%								
	Fixed, north, ≤ 40%								
	Operable, all, ≤ 40%								
	Operable, north, ≤ 40%								
90.1-2007	Nonmetal framing, all								
	Metal framing, curtainwall, etc.								
	Metal framing, all other								
	Metal framing, entrance door								
90.1-2010	Nonmetal framing, all								
	Metal framing, curtainwall, etc.								
	Metal framing, all other								
	Metal framing, entrance door								
90.1-2013	Nonmetal framing, all								
	Metal framing, fixed	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
	Metal framing, operable	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
	Metal framing, entrance door	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10



Light-to-Solar Gain Ratio for insulating glass units for all glasses in LBNL International Glazing Data Base (IGDB)



# If Glass Cannot Be Avoided — Shade It



# Fenestration & Doors

NFRC shall be used to determine compliance for:

- U-Factor
  - NFRC 100
- Solar Heat Gain Coefficient
  - NFRC 200
- Visible Light Transmittance
  - NFRC 200
- Air Leakage
  - NFRC 400



National Fenestration Rating Council

**CERTIFIED**

**World's Best Window Co.**

**Millennium 2000+ Casement**

Vinyl-Clad Wood Frame  
Double Glaze • Argon Fill • Low E

ENERGY Performance

- Energy savings will depend on your specific climate, house and lifestyle
- For more information, call [manufacturer's phone number] or visit NFRC's web site at [www.nfrc.org](http://www.nfrc.org)

Technical Information								
Res	U-Factor	<b>.32</b>	Solar Heat Gain Coefficient	<b>.45</b>	Visible Transmittance	<b>.58</b>	Air Leakage	<b>.3</b>
Non-Res		<b>.31</b>		<b>.45</b>		<b>.60</b>		<b>.3</b>

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product energy performance. NFRC ratings are determined for a fixed set of environmental conditions and specific product sizes.

*References to updated NFRC test procedures were updated via Addendum q to 90.1-2010.*

# Fenestration Prescriptive Requirements

**5.5.4.2.3 Minimum *Skylight* Fenestration Area.** In any *enclosed space* in a building that is four stories or less and that is:

- a. greater than ~~5,000 ft<sup>2</sup>~~ 2,500 ft<sup>2</sup> and,
- b. directly under a roof with ceiling heights greater than 15 ft, and
- c. one of the following space types: office, lobby, atrium, concourse, corridor, storage (including non-refrigerated warehouse), gymnasium, fitness/exercise area, playing area, gymnasium seating area, convention exhibit/event space, courtroom, automotive service, fire station engine room, manufacturing corridor/transition and bay areas, retail, library reading and stack areas, distribution/sorting area, transportation baggage and seating areas, or workshop,

the total *daylight area under skylights* shall be a minimum of half the floor area and either:

- a. provide a minimum *skylight area to daylight area under skylights* of 3% with a skylight VT of at least 0.40 or
- b. provide a minimum *skylight effective aperture* of at least 1%.

# Changes to Mechanical sections 6 & 7

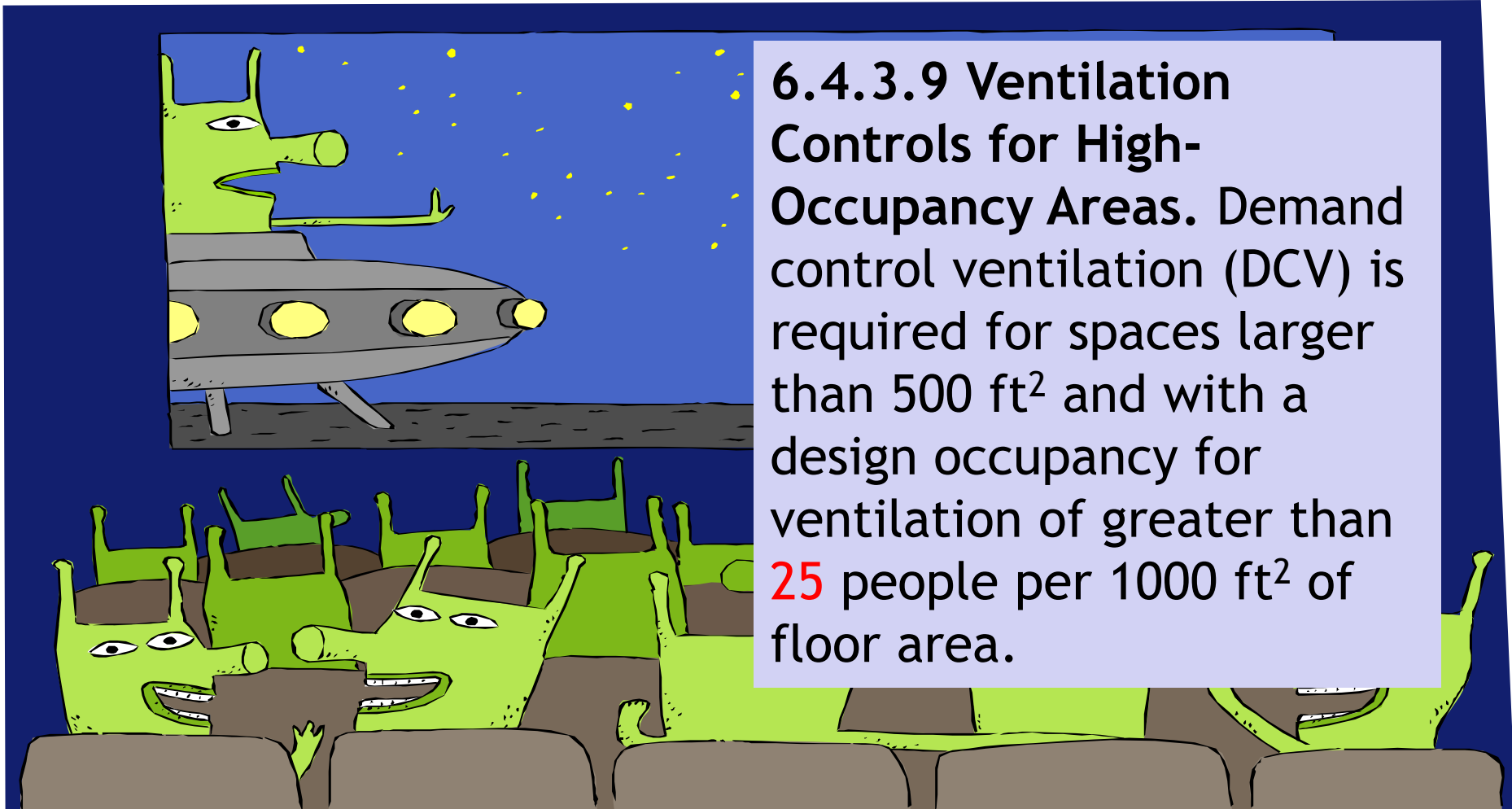
# Refrigeration New for 2013 (see 6.5.11-6.4.5-6.4.6)

- **6.1.1.1 New Buildings. Mechanical equipment and systems** serving the heating, cooling, ventilating, **or refrigeration** needs of new buildings shall comply with the requirements of this section as described in Section 6.2.
- **6.1.1.2 Additions to Existing Buildings. Mechanical** equipment and systems serving the heating, cooling, ventilating, **or refrigeration** needs of additions to existing buildings shall comply with the requirements of this section as described in Section 6.2.
- **6.1.1.3.1 New HVACR equipment as a direct replacement** of existing **HVACR** equipment shall comply with the specific minimum efficiency requirements applicable to that equipment.

# New Definition for Piping

- ***piping***: the pipes or tubes interconnecting the various parts of a fluid distribution system, including all elements that are in series with the fluid flow, such as pumps, valves, strainers, and air separators, but not including elements that are not in series with the fluid flow, such as expansion tanks, fill lines, chemical feeders, and drains

# DCV Control



**6.4.3.9 Ventilation Controls for High-Occupancy Areas.** Demand control ventilation (DCV) is required for spaces larger than 500 ft<sup>2</sup> and with a design occupancy for ventilation of greater than **25** people per 1000 ft<sup>2</sup> of floor area.



# 6.4.3.10 Direct Digital Control (DDC) Requirements (Shall be Provided)

TABLE 6.4.3.10.1 DDC Applications and Qualifications

Building Status	Application	Qualifications
New building	Air-handling system and all zones served by the system	Individual systems supplying more than three zones and with fan system bhp of 10 hp and larger
New building	Chilled-water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design cooling capacity of 300,000 Btu/h and larger
New building	Hot-water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design heating capacity of 300,000 Btu/h and larger
Alteration or addition	Zone terminal unit such as VAV box	Where existing zones served by the same air-handling, chilled-water, or hot-water system have DDC
Alteration or addition	Air-handling system or fan coil	Where existing air-handling system(s) and fan-coil(s) served by the same chilled- or hot-water plant have DDC
Alteration or addition	New air-handling system and all new zones served by the system	Individual systems with fan system bhp of 10 hp and larger and supplying more than three zones and more than 75% of zones are new
Alteration or addition	New or upgraded chilled-water plant	Where all chillers are new and plant design cooling capacity is 300,000 Btu/h and larger
Alteration or addition	New or upgraded hot-water plant	Where all boilers are new and plant design heating capacity is 300,000 Btu/h and larger

## 6.4.3.10.2 DDC Controls

The DDC system shall be capable of all of the following, as required, to provide the control logic required in Section 6.5:

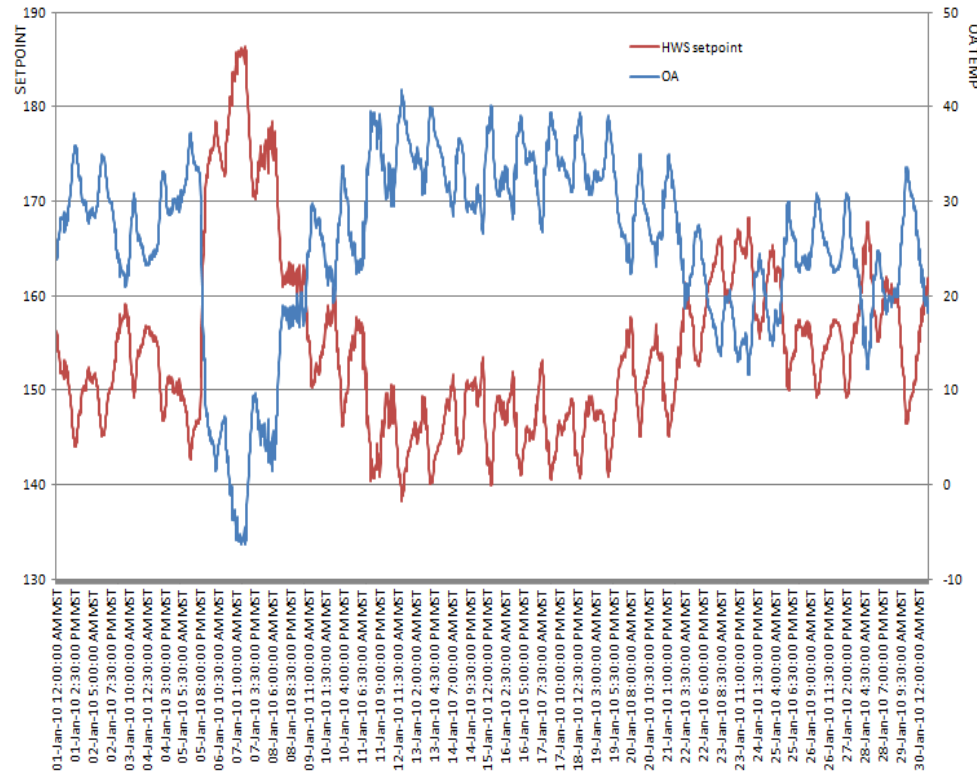
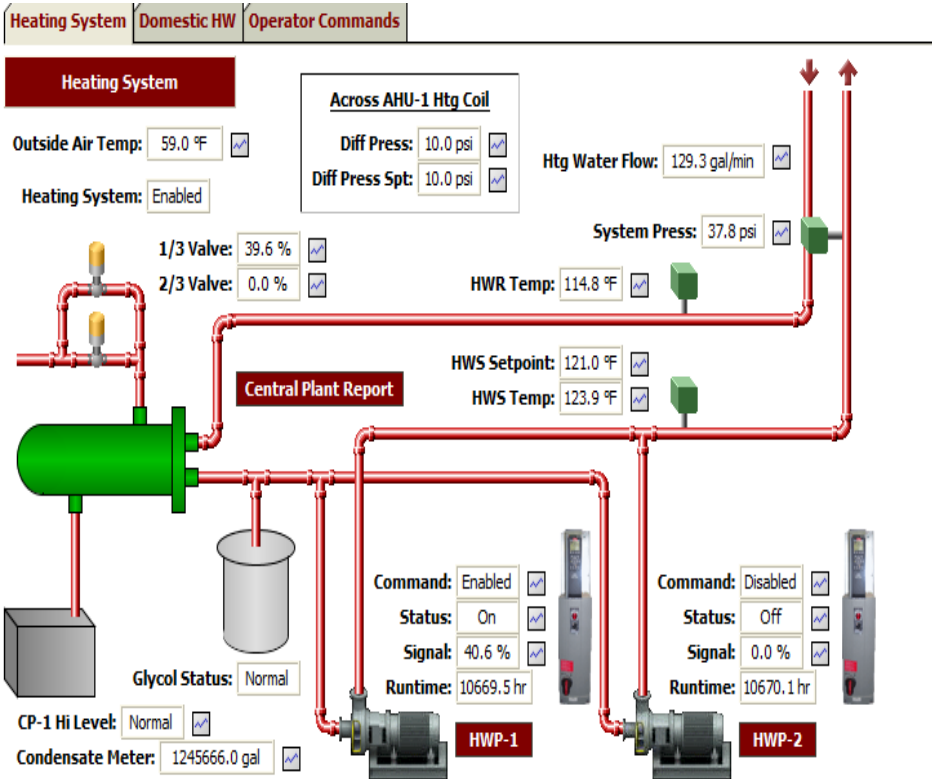
Monitoring zone and system demand for fan pressure, pump pressure, heating and cooling

Transferring zone and system demand information from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers

Automatically detecting those zones and systems that may be excessively driving the reset logic and generate an alarm or other indication to the system operator

Readily allowing operator removal of zone(s) from the reset algorithm

# 6.4.3.10.3 DDC Display



DDC must trend and graphically display input and output points

# HVAC Prescriptive Requirements

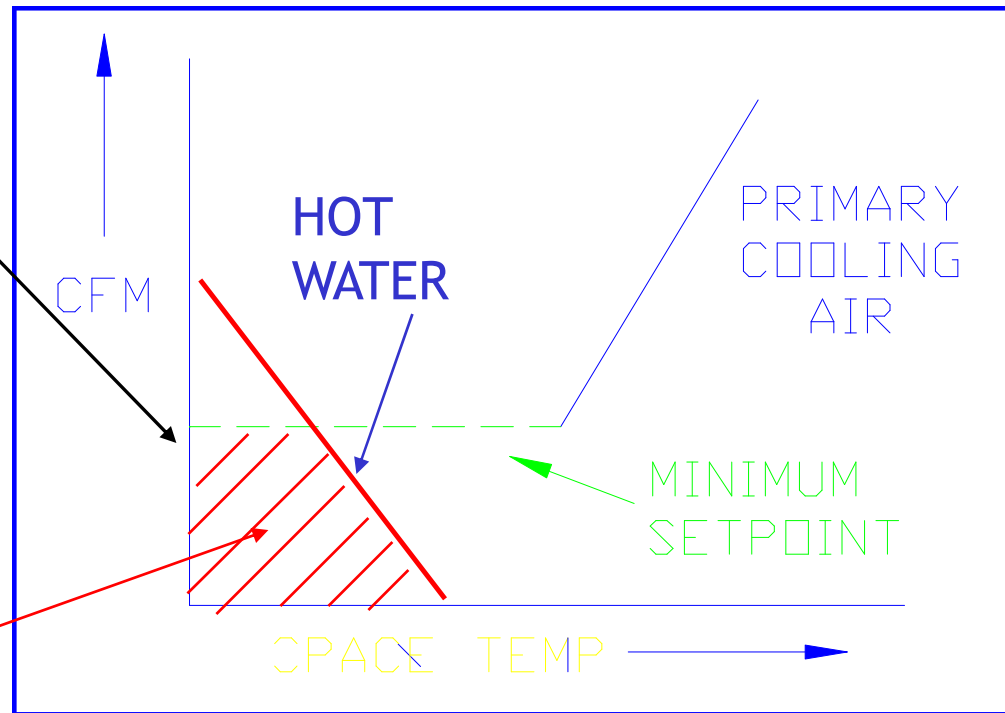
## 6.5.2.1 Zone Reheat Limitation (No DDC)

### VAV Reheat Zone

Minimum Setpoint no larger than the larger of:

- 30% of peak
- ~~0.4 cfm/ft<sup>2</sup>~~
- Min. OA vent. rate
- ~~300 cfm~~
- Approved alternate
- **Required by other codes**

**Reheat Energy**



# HVAC Prescriptive Requirements 6.5.2.1

## Zone Reheat Limitation (with DDC)

- 20% of design peak airflow
- Reheated air can be 50% of design peak airflow
- Air between dead band and full heating or cooling is modulated

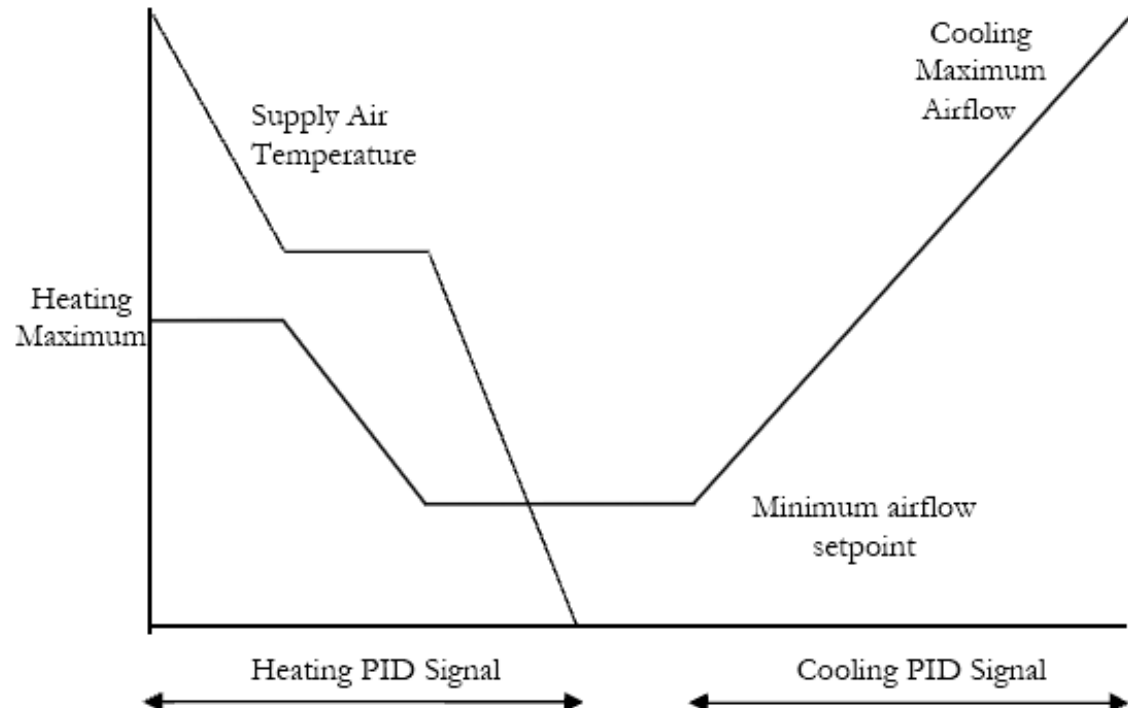
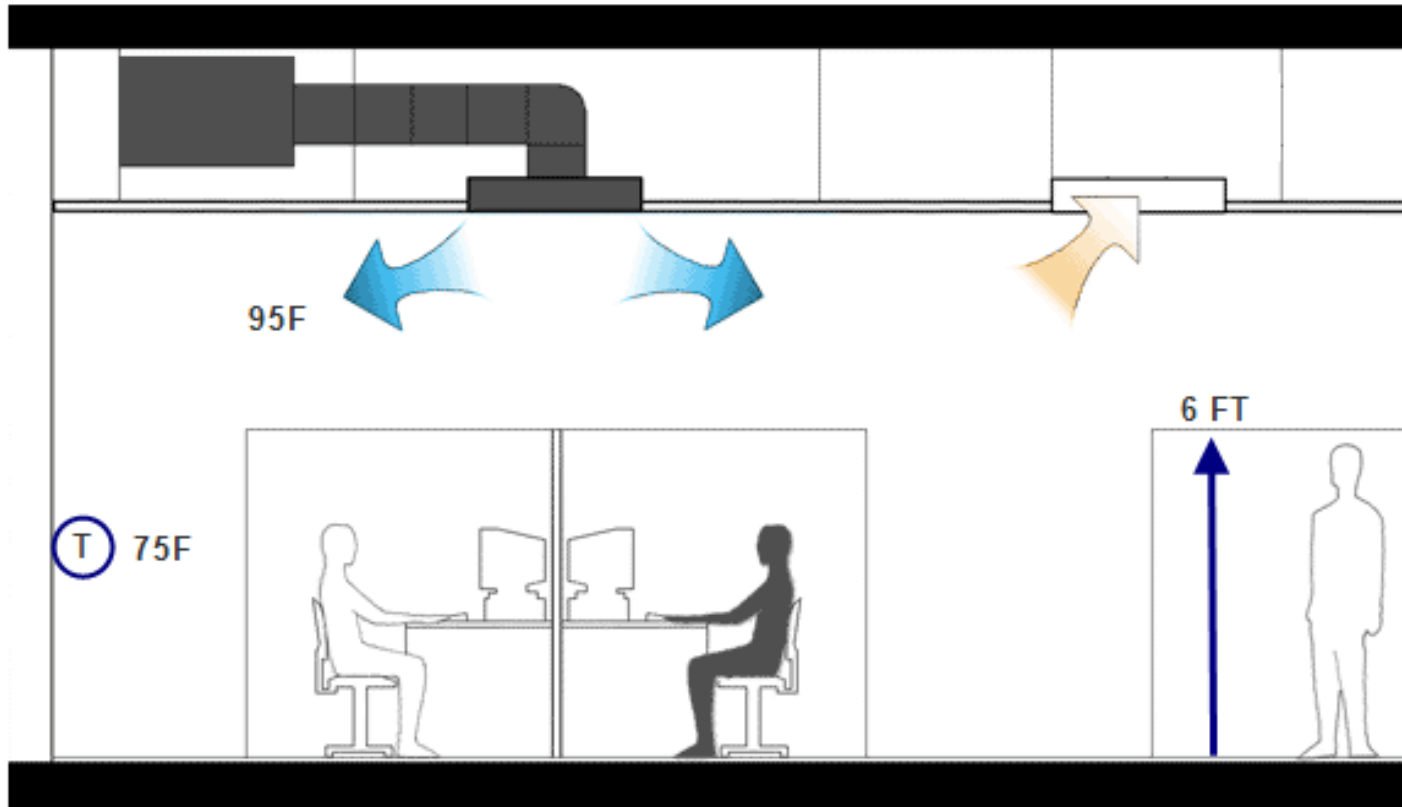


Figure 6-R. Example VAV Reheat Sequence That Meets Exception b to 6.5.2.1

# 6.5.2.1.1 Overhead Supply Air Temperatures Limited



## EXCEPTIONS:

- WARM-UP OR SETBACK
- LABS

# 6.5.3.1.3 Fan Efficiency

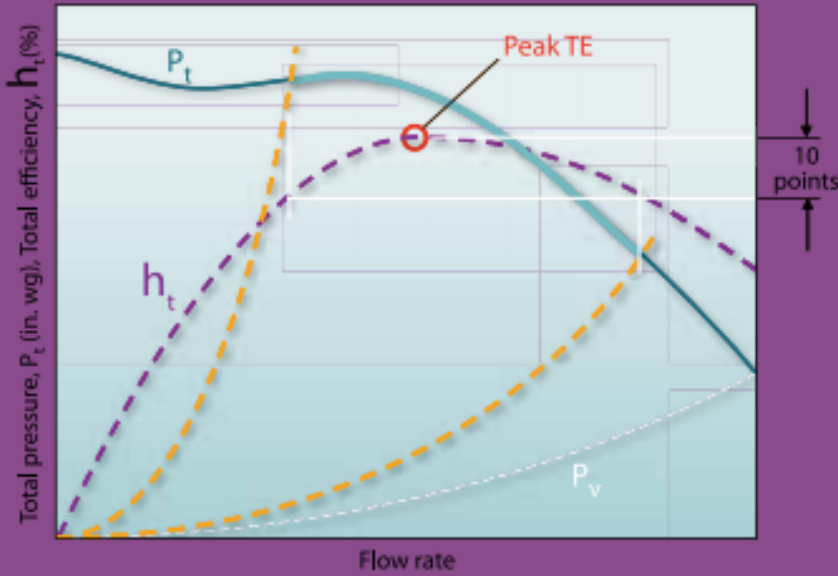


Figure 1: A typical fan curve showing the 10-point total efficiency band.

Design total efficiency  $\geq$  maximum fan total efficiency -15%-points

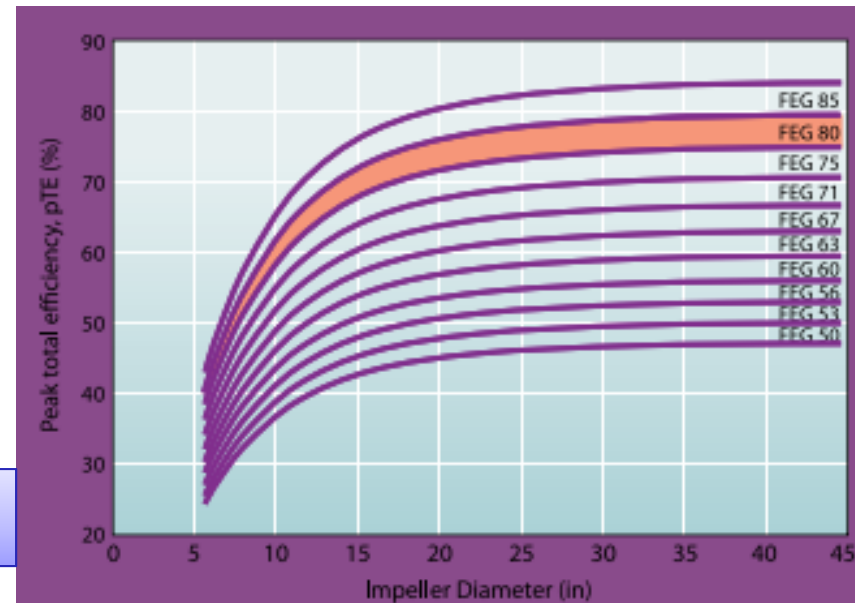


Figure 3: FEG band area for FEG80.

FEG (fan efficiency grade)  $\geq$  67

From amca.org website  
Air Movement and Control Association

# HVAC Prescriptive Section 6.5.3.2.2

## Static Pressure Sensor Location

- 6.5.3.2.2 VAV Sensor controlling fan must be located such that its setpoint  $\leq 1.2$  in. wc
  - If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch. Exception: Systems using 6.5.3.2.3
- 6.5.3.2.3 VAV Setpoint Reset
  - For systems with digital control at zone level, setpoint must be reset based on zone requiring greatest pressure.
  - The setpoint is reset lower until one zone damper is nearly wide open.



## 6.5.3.5 Fractional Horsepower Fan Motors

### Electrically-Commutated Motors

1/12 HP  $\leq$   
Motors  $\leq$   
1HP

Minimum  
rated  
efficiency  
70%

Adjust  
speed for  
balancing or  
remote  
control

## 6.5.4.1 Boiler Turndown

**TABLE 6.5.4.1 Boiler Turndown**

<b>Boiler System Design Input, Btu/h</b>	<b>Minimum Turndown Ratio</b>
$\geq 1,000,000$ and $\leq 5,000,000$	3 to 1
$> 5,000,000$ and $\leq 10,000,000$	4 to 1
$> 10,000,000$	5 to 1

The system turndown requirement shall be met through the use of multiple single-input boilers, one or more modulating boilers, or a combination of single-input and modulating boilers.

# 6.5.6 Energy Recovery

**TABLE 6.5.6.1-1 Exhaust Air Energy Recovery Requirements for Ventilation Systems Operating Less than 8000 Hours per Year**

Zone	% Outdoor Air at Full Design Airflow Rate							
	≥10% and <20%	≥20% and <30%	≥30% and <40%	≥40% and <50%	≥50% and <60%	≥60% and <70%	≥70% and <80%	≥80%
Design Supply Fan Airflow Rate, cfm								
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B,5C	NR	NR	NR	NR	≥26000	≥12000	≥5000	≥4000
6B	≥28,000	≥26,500	≥11000	≥5500	≥4500	≥3500	≥2500	≥1500
1A, 2A, 3A, 4A, 5A, 6A	≥26,000	≥16,000	≥5500	≥4500	≥3500	≥2000	≥1000	>0
7,8	≥4500	≥4000	≥2500	≥1000	>0	>0	>0	>0

NR—Not required

Many Exceptions including heating in Zones 1&2; cooling in Zones 3c, 4c, 5b, 5c, 6b, 7 and 8; and any system that has less than 75% of the exhaust at a single location

## 6.5.6 Energy Recovery

**TABLE 6.5.6.1-2 Exhaust Air Energy Recovery Requirements  
for Ventilation Systems Operating Greater than or Equal to 8000 Hours per Year**

Zone	% Outdoor Air at Full Design Airflow Rate							
	≥10% and <20%	≥20% and <30%	≥30% and <40%	≥40% and <50%	≥50% and <60%	≥60% and <70%	≥70% and <80%	≥80%
	Design Supply Fan Airflow Rate, cfm							
3C	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 3B, 4C, 5C	NR	≥19,500	≥9000	≥5000	≥4000	≥3000	≥1500	>0
1A, 2A, 3A, 4B, 5B	≥2500	≥2000	≥1000	≥500	>0	>0	>0	>0
4A, 5A, 6A, 6B, 7, 8	>0	>0	>0	>0	>0	>0	>0	>0

NR—Not required

Many Exceptions including heating in Zones 1&2; cooling in Zones 3c, 4c, 5b, 5c, 6b, 7 and 8; and any system that has less than 75% of the exhaust at a single location

## 6.5.10 Door Switches

Exception:  
Doors with  
closers

Any conditioned  
space with a door

Heating: reset  
setpoint to  $\leq 55^{\circ}\text{F}$   
 $\leq 5$  min of opening  
or disable heating

Cooling: reset  
setpoint to  $\geq 90^{\circ}\text{F}$   
 $\leq 5$  min of opening  
or disable cooling

## 7.5.3 Buildings with High-Capacity Service Water Heating Systems

- New Buildings
- Installed input capacity  $\geq 1,000,000$  Btu/h
- Minimum thermal efficiency ( $E_t$ ) of 90%
- Can use input capacity averaging over multiple units