

## **ASHRAE 2007 Implementation:**

### Changes to HVAC systems and Lighting:

- Revised table 13-407-ABC.3.2.1A. Specific changes implemented in EnergyGauge Summit/Flacom 2008 are:
  - Single Packages Vertical Air Conditioners (SPVAC – cooling mode) has multiple categories based on capacities. EER values have changed from a common value of 8.6 to values 9.0, 8.9 and 8.6 for capacities of less than 65,000 Btu/h, between 65,000 and 135,000 Btu/h and more than 135,000 but less than 240,000 Btu/h respectively.
  - Single Packages Vertical Heat Pump (SPVHP – cooling mode) has multiple categories based on capacities. EER values have changed from a common value of 8.6 to values 9.0, 8.9 and 8.6 for capacities of less than 65,000 Btu/h, between 65,000 and 135,000 Btu/h and more than 135,000 but less than 240,000 Btu/h respectively.
  - Single Packages Vertical Heat Pump (SPVAC – heating mode) has multiple categories based on capacities. COP values have changed from a common value of 2.7 to values 3.0, 3.9 and 2.9 for capacities of less than 65,000 Btu/h, between 65,000 and 135,000 Btu/h and more than 135,000 but less than 240,000 Btu/h respectively.
- Changed Table 13-408.ABC.3.2.1F to add additional requirement of combustion efficiency to current requirement of thermal efficiency for boilers with capacity > 2,500,000 Btu/h, which will increase minimum efficiency. Specific changes implemented in EnergyGauge Summit/Flacom 2008 are:
  - Required combustion efficiency of 80% for gas-fired boilers
  - Required combustion efficiency of 83% for oil-fired boilers
  - Required combustion efficiency of 83% for oil-fired boilers (residual)
- Changed lighting power density (LPD) for space types and building types for tables 13-415.B.1 and 13-415.C.1 as per ASHRAE 90.1 2007 data
- Fan power limitations have been modified as reflected in tables 13-410.ABC.1.1.1A and 13-410.ABC.1.1.1B as per addendum ac for the ASHRAE 90.1 2004
- Lighting power for each thermal block will be used in the proposed building model for the Energy Cost Budget Method calculation as per addendum ae to ASHRAE 90.1 2004
- Interior lighting power requirements modified for retail spaces designed and directed to highlight merchandise, with new calculation for additional lighting power allowance from formula as per addendum ai to ASHRAE 90.1 2004.
- Commonly used furniture mounted track lights exempted if they have automatic shut-off as per addendum m for ASHRAE 90.1 2004

- Addition of footnote to Table 13-408.ABC.3.2.1E mandates increasing unit heater efficiency with addition of interrupted or intermittent ignition device (IID) as per addendum ao for ASHRAE 90.1 2004

#### Changes to Building Envelope:

- Particular U-values and R-values for roofs, walls, floors, fenestration (including skylights), and doors have been updated for zones 1 and zone 2 as per changes in ASHRAE 90.1 2007 data as compared to 2004. Refer to Appendix A for details of changes made as per addenda as and at to ASHRAE 90.1 2004.
- U-values for vertical glazing have changed to a single value for window areas ranging from 0 to 40% in ASHRAE 90.1 2007
- 4 new categories of windows have been specified in the ASHRAE 90.1 2007 data as compared to ASHRAE 90.1 2004
- Table 13-404.C.1.1 provides new U-values and R-values for high albedo roof insulation
- New multiplication factor to be used for demonstrating compliance for vertical fenestration as per addendum n to ASHRAE 90.1 2004

#### **ASHRAE Advanced Design Guides:**

Following is the summary of changes in ASHRAE Advanced Design Guides (AADG) recommendations as compared to ASHRAE 90.1 2004 data used for the earlier version of the Florida code. **Detailed tabular comparison of data for AADG recommendations versus ASHRAE 90.1 2004 data is presented in Appendix A.** This comparison is valid only for ASHRAE climate zones 1 and 2.

#### AADG - Small Office:

- ASHRAE Advanced Design Guide for Small Office specifies a surface reflectance value of 0.65 and surface emittance value of 0.86 for roofs
- All floors have specified R-values in the AADG where as there is no specific recommended value in the ASHRAE 90.1 2004 standard
- No recommendation in AADG for heated slabs
- Recommended values for swinging and non-swinging doors in AADG
- Recommended U-values for vertical glazing more stringent AADG as compared to ASHRAE 90.1 2004
- Higher SHGC values allowed in AADG for all directions except North as compared to ASHRAE 90.1 2004
- Window orientation and wall area to window glass area ratio recommendations differ in AADG as compared to ASHRAE 90.1 2004
- Skylights limited to 3% of roof area as per AADG compared to 5% for ASHRAE 90.1 2004
- Higher U-values allowed for skylights as per AADG as compared to ASHRAE 90.1 2004
- More stringent SHGC requirements for skylights as per AADG

- Projection factor equal to 0.5 in the AADG as compared to ASHRAE 90.1-2004. EnergyGauge Summit models overhangs as is.
- Internal lighting power density of 0.9 for AADG as compared to 1 W/ft<sup>2</sup> for ASHRAE 90.1 2004
- Specific recommendations for light source, ballast, dimming controls and interior room surface reflectance as compared to ASHRAE 90.1 2004
- Higher efficiencies for air cooled air conditioners, gas furnaces and heat pumps recommended by the AADG as compared to ASHRAE 90.1 2004

#### AADG - Small Retail:

- ASHRAE Advanced Design Guide for Small Retail specifies a surface reflectance value of 0.65 and surface emittance value of 0.86 for roofs
- Roof categories attic and other and single rafter have larger insulation requirements in the AADG as compared to ASHRAE 90.1 2004
- No recommendation for mass wall R-value in ASHRAE 90.1 2004
- All floors have specified R-values in the AADG where as there is no specific recommended value in the ASHRAE 90.1 2004 standard
- No recommendation in AADG for heated slabs
- Recommended values for swinging and non-swinging doors in AADG
- Recommended U-values for vertical glazing more stringent AADG as compared to ASHRAE 90.1 2004
- Higher SHGC values allowed in AADG for all directions except North as compared to ASHRAE 90.1 2004
- Window orientation and wall area to window glass area ratio recommendations differ in AADG as compared to ASHRAE 90.1 2004
- Skylights limited to 3% of roof area as per AADG compared to 5% for ASHRAE 90.1 2004
- Higher U-values allowed for skylights as per AADG as compared to ASHRAE 90.1 2004
- More stringent SHGC requirements for skylights as per AADG
- Projection factor should be greater than 0.5 as compared to ASHRAE 90.1-2004. EnergyGauge Summit models overhangs as is.
- Internal lighting power density of 0.9 for AADG as compared to 1 W/ft<sup>2</sup> for ASHRAE 90.1 2004
- Specific recommendations for light source, ballast, dimming controls and interior room surface reflectance as compared to ASHRAE 90.1 2004
- Higher efficiencies for air cooled air conditioners, gas furnaces and heat pumps recommended by the AADG as compared to ASHRAE 90.1 2004

#### AADG – K-12 Schools:

- ASHRAE Advanced Design Guide for K-12 School Buildings specifies a surface reflectance value of 0.78
- Recommendation for a mass wall R-value and higher insulation for metal walls in AADG as compared to ASHRAE 90.1 2004

- All floors have specified R-values in the AADG where as there is no specific recommended value in the ASHRAE 90.1 2004 standard
- Recommended values for swinging and non-swinging doors in AADG
- Window to wall ratio limited to a maximum of 35% in the AADG as compared to 40% for ASHRAE 90.1 2004
- Recommended U-values for vertical glazing more stringent AADG as compared to ASHRAE 90.1 2004
- Higher SHGC values allowed in AADG for all directions except North as compared to ASHRAE 90.1 2004
- Projection factor should be greater than 0.5 as compared to ASHRAE 90.1-2004. EnergyGauge Summit models overhangs as is.
- Detailed interior lighting-daylighting recommendations in the AADG as compared to ASHRAE 90.1 2004
- Specific recommendations interior room surface reflectance in the AADG as compared to ASHRAE 90.1 2004
- Higher efficiencies for packaged rooftop air cooled air conditioners (single and split), gas furnaces, heat pumps, water source heat pumps, chiller units etc. recommended by the AADG as compared to ASHRAE 90.1 2004

## APPENDIX A

**TABLE 5.5-1 Building Envelope Requirements For Climate Zone 1 (A, B)**

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
Roofs						
Insulation Entirely above Deck			U-0.063 U-0.048	R-15 c.i. R-20 c.i.	U-1.282 U-0.218	R-NR R-3.8 c.i.
Metal Building						
Attic and Other					U-0.614 U-0.081	R-NR R-13
Walls, Above-Grade						
Mass						
Metal Building						
Steel-Framed						
Wood-Framed and Other						
Walls, Below-Grade						
Below-Grade Wall						
Floors						
Mass						
Steel-Joist						
Wood-Framed and Other						
Slab-On_Grade Floors						
Unheated						
Heated						
Opaque Doors						
Swinging						
Nonswinging						
<b>Fenestration</b>	<b>Assembly Max. U</b>	<b>Assembly Max. SHGC</b>	<b>Assembly Max. U</b>	<b>Assembly Max. SHGC</b>	<b>Assembly Max. U</b>	<b>Assembly Max. SHGC</b>
Vertical Glazing, 0%-40% of Wall						
Nonmetal framing (all)	U-1.22		U-1.22		U-1.22	

	U-1.2		U-1.2		U-1.2	
Metal framing (curtainwall/storefront)	U-1.22 U-1.2		U-1.22 U-1.2		U-1.22 U-1.2	
Metal framing (entrance door)	U-1.22 U-1.2		U-1.22 U-1.2		U-1.22 U-1.2	
Metal framing (all other)	U-1.22 U-1.2		U-1.22 U-1.2		U-1.22 U-1.2	
<b>Skylight</b>	<b>Assembly Max. U</b>	<b>Assembly Max. SHGC</b>	<b>Assembly Max. U</b>	<b>Assembly Max. SHGC</b>	<b>Assembly Max. U</b>	<b>Assembly Max. SHGC</b>
Skylight with Curb, Glass, % of Roof						
0 % - 2.0 %						
2.1 % - 5.0 %						
Skylight with Curb, Plastic, % of Roof						
0 % - 2.0 %						
2.1 % - 5.0 %						
Skylight without Curb, All, % of Roof						
0 % - 2.0 %						
2.1 % - 5.0 %						

Note: red text denotes strikeouts in ASHRAE 90.1 2007, black text denotes current value

**TABLE 5.5-2 Building Envelope Requirements For Climate Zone 2 (A, B)**

Opaque Elements	Nonresidential		Residential			Semiheated	
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation R-Value	Min.	Assembly Maximum	Insulation Min. R-Value
<b>Roofs</b>							
Insulation Entirely above Deck	U-0.063 U-0.048	R-15 c.i. R-20 c.i.	U-0.063 U-0.048	R-15 c.i. R-20 c.i.			
Metal Building							
Attic and Other	U-0.034 U-0.027	R-30 R-38					
<b>Walls, Above-Grade</b>							
Mass	U-0.58 U-0.151	R-NR R-5.7 c.i.	U-0.151 U-0.123	R-5.7 c.i. R-7.6 c.i.			
Metal Building							
Steel-Framed			U-0.124 U-0.064	R-13 R-13+R-7.5c.i.	U-0.352 U-0.124	R-NR R-13	
Wood-Framed and Other					U-0.292 U-0.089	R-NR R-13	
<b>Walls, Below-Grade</b>							
Below-Grade Wall							
<b>Floors</b>							
Mass	U-0.137 U-0.107	R-4.2 c.i. R-6.3 c.i.	U-0.107 U-0.087	R-6.3 c.i. R-8.3 c.i.			
Steel-Joist					U-0.35 U-0.069	R-NR R-13	
Wood-Framed and Other			U-0.051 U-0.033	R-19 R-30	U-0.282 U-0.066	R-NR R-13	
<b>Slab-On_Grade Floors</b>							
Unheated							
Heated							
<b>Opaque Doors</b>							
Swinging							
Nonswinging			U-1.45 U-0.500				
<b>Fenestration</b>							
	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Max. U	Assembly Max. U	Assembly Max. SHGC
<b>Vertical Glazing, 0%-40% of Wall</b>							
Nonmetal framing (all)	U-1.22 U-0.75		U-1.22 U-0.75			U-1.22 U-1.2	
Metal framing (curtainwall/storefront)	U-1.22 U-0.70		U-1.22 U-0.70			U-1.22 U-1.2	
Metal framing (entrance door)	U-1.22 U-1.10		U-1.22 U-1.10			U-1.22 U-1.2	
Metal framing (all other)	U-1.22 U-0.75		U-1.22 U-0.75			U-1.22 U-1.2	
<b>Skylight</b>							
	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Max. U	Assembly Max. U	Assembly Max. SHGC
<b>Skylight with Curb, Glass, % of Roof</b>							
0 % - 2.0 %							
2.1 % - 5.0 %							
<b>Skylight with Curb, Plastic, % of Roof</b>							
0 % - 2.0 %							
2.1 % - 5.0 %							
<b>Skylight without Curb, All, % of Roof</b>							
0 % - 2.0 %							
2.1 % - 5.0 %							

**Climate Zone 1 and 2 Recommendation Table: AADG - Small Office**

Item	Component	Recommendation	ASHRAE 90.1 2004	
Roof	Insulation entirely above deck	R-15 c.i.	R-15 c.i.	
	Metal building	R-19	R-19	
	Attic and other	R-30	R-30	
	Single rafter	R-30	R-30	
	Surface reflectance/emittance	0.65 initial/0.86	No recommendation	
Walls	Mass (HC>7 Btu/ft <sup>2</sup> )	No recommendation	No recommendation	
	Metal building	R-13	R-13	
	Steel framed	R-13	R-13	
	Wood framed and other	R-13	R-13	
	Below-grade walls	No recommendation	No recommendation	
Floors	Mass	R-4.2 c.i.	No recommendation	
	Steel framed	R-19	No recommendation	
	Wood framed and other	R-19	No recommendation	
Slabs	Unheated	No recommendation	No recommendation	
	Heated	No recommendation	R-7.5 for 12 in.	
Doors	Swinging	U-0.70	No recommendation	
	Non-swinging	U-1.45	No recommendation	
Vert. Glazing	Window to wall ratio (WWR)	20% to 40% maximum	40% maximum	
	Thermal transmittance	U-0.56	Fixed	Operable
			U-1.22	1.27
	Solar heat gain coefficient (SHGC)	N, S, E, W - 0.35   N only - 0.49	0.25 all / 0.61 North	
	Window orientation	$(A_N * SHGC_N + A_S * SHGC_S) > (A_E * SHGC_E + A_W * SHGC_W)$	Directional and < 50% of wall area	
Exterior sun control (S, E, W only)	Projection factor (PF) 0.5	Based on PF		
Skylights	Maximum percent of roof area	3%	0%-2%	2.1%-5%
	Thermal transmittance	U-1.36	U-1.22	U-1.22
	Solar heat gain coefficient (SHGC)	0.19	0.36	0.19
Int. Lighting	Lighting power density (LPD)	0.9 W/ ft <sup>2</sup>	1.0 W/ ft <sup>2</sup>	
	Light source (linear fluorescent)	90 mean lumens/watt	No recommendation	
	Ballast	Electronic ballast	No recommendation	
	Dimming controls for daylight Harvesting for WWR ≥ 25%	Dim fixtures within 12 ft of N/S window wall or within 8 ft of skylight edge	No recommendation	
	Interior room surface reflectances	80%+ on ceilings, 70%+ on walls and vertical partitions	No recommendation	
HVAC	Air conditioner (0-65 kBtu/h)	13.0 SEER	12.0 SEER	
	Air conditioner (>65-135 kBtu/h)	11.3 EER / 11.5 IPLV	10.3 EER	
	Air conditioner (>135-240 kBtu/h)	11.0 EER / 11.5 IPLV	9.7 EER	
	Air conditioner (>240 kBtu/h)	10.6 EER / 11.2 IPLV	9.5 EER / 9.7 IPLV	
	Gas furnace (0-225 kBtu/h – SP)	80% AFUE or E <sub>t</sub>	78% AFUE or 80% E <sub>t</sub>	
	Gas furnace (0-225 kBtu/h – Split)	80% AFUE or E <sub>t</sub>	78% AFUE or 80% E <sub>t</sub>	
	Gas furnace (>225 kBtu/h)	80% E <sub>c</sub>	80% E <sub>c</sub>	
	Heat pump (0-65 kBtu/h)	13 SEER / 7.7 HSPF	12 SEER / 7.4 HSPF	
	Heat pump (>65-135 kBtu/h)	10.6 EER / 11.0 IPLV / 3.2 COP	10.1 EER / 3.2 COP	
Heat pump (>135 kBtu/h)	10.1 EER / 11.5 IPLV / 3.1 COP	9.5 EER / 3.1 COP		
Economizer	Air conditioners & heat pumps - SP	No recommendation	No recommendation	
Ventilation	Outdoor air damper	Motorized control	Motorized control	
	Demand control	CO <sub>2</sub> sensors	CO <sub>2</sub> sensors	
Ducts	Friction rate	0.08 in. w.c. / 100 feet	No recommendation	
	Sealing	Seal class B	Seal class C	
	Location	Interior only	No recommendation	
	Insulation level	R-6	R-6	
Service Water Heater	Gas storage	90% E <sub>t</sub>	(0.62 – 0.0019V)	
	Gas instantaneous	0.81 EF or 81% E <sub>t</sub>	(0.62 – 0.0019V)	

	Electric storage 12 kW	$EF > 0.99 - 0.0012 * \text{Volume}$	$EF > 0.93 - 0.0032V$
	Pipe insulation (d < 1 1/2 in / d > 1 1/2 in)	1 in. / 1 1/2 in.	1/2 in. / 1 in

**Climate Zone 1 and 2 Recommendation Table: AADG - Small Retail**

Item	Component	Recommendation	ASHRAE 90.1 2004	
Roof	Insulation entirely above deck	R-15 c.i.	R-15 c.i.	
	Metal building	R-19	R-19	
	Attic and other	R-38	R-30	
	Single rafter	R-38	R-30	
	Surface reflectance/emittance	0.65 initial/0.86	No recommendation	
Walls	Mass ( $HC > 7 \text{ Btu/ft}^2$ )	R-7.6 c.i.	No recommendation	
	Metal building	R-13	R-13	
	Steel framed	R-13	R-13	
	Wood framed and other	R-13	R-13	
	Below-grade walls	No recommendation	No recommendation	
Floors	Mass	R-6.3 c.i.	No recommendation	
	Steel framed	R-19	No recommendation	
	Wood framed and other	R-19	No recommendation	
Slabs	Unheated	No recommendation	No recommendation	
	Heated	No recommendation	R-7.5 for 12 in.	
Doors	Swinging	U-0.70	No recommendation	
	Non-swinging	U-1.45	No recommendation	
Vert. Glazing	Window to wall ratio (WWR)	20% to 40% maximum	40% maximum	
	Thermal transmittance	U-0.45	Fixed	Operable
			U-1.22	U-1.27
	Solar heat gain coefficient (SHGC)	N, S, E, W - 0.31   N only - 0.44	0.25 all / 0.61 North	
	Window orientation	$(A_N * SHGC_N + A_S * SHGC_S) > (A_E * SHGC_E + A_W * SHGC_W)$	Directional and < 50% of wall area	
Exterior sun control (S, E, W only)	Projection factor (PF) 0.5	Based on PF		
Skylights	Maximum percent of roof area	3%	0%-2%	2.1%-5%
	Thermal transmittance	U-1.36	U-1.22	U-1.22
	Solar heat gain coefficient (SHGC)	0.19	0.36	0.19
Int. Lighting	Lighting power density (LPD)	0.9 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup>	
	Light source (linear fluorescent)	90 mean lumens/watt	No recommendation	
	Ballast	Electronic ballast	No recommendation	
	Dimming controls for daylight Harvesting for WWR ≥ 25%	Dim fixtures within 12 ft of N/S window wall or within 8 ft of skylight edge	No recommendation	
	Interior room surface reflectances	80%+ on ceilings, 70%+ on walls and vertical partitions	No recommendation	
HVAC	Air conditioner (0-65 kBtu/h)	13.0 SEER	12.0 SEER	
	Air conditioner (>65-135 kBtu/h)	11.3 EER / 11.5 IPLV	10.3 EER	
	Air conditioner (>135-240 kBtu/h)	11.0 EER / 11.5 IPLV	9.7 EER	
	Air conditioner (>240 kBtu/h)	10.6 EER / 11.2 IPLV	9.5 EER / 9.7 IPLV	
	Gas furnace (0-225 kBtu/h – SP)	80% AFUE or E <sub>t</sub>	78% AFUE or 80% E <sub>t</sub>	
	Gas furnace (0-225 kBtu/h – Split)	80% AFUE or E <sub>t</sub>	78% AFUE or 80% E <sub>t</sub>	
	Gas furnace (>225 kBtu/h)	80% E <sub>c</sub>	80% E <sub>c</sub>	
	Heat pump (0-65 kBtu/h)	13 SEER / 7.7 HSPF	12 SEER / 7.4 HSPF	
	Heat pump (>65-135 kBtu/h)	10.6 EER / 11.0 IPLV / 3.2 COP	10.1 EER / 3.2 COP	
Heat pump (>135 kBtu/h)	10.1 EER / 11.5 IPLV / 3.1 COP	9.5 EER / 3.1 COP		
Economizer	Air conditioners & heat pumps - SP	No recommendation	No recommendation	
Ventilation	Outdoor air damper	Motorized control	Motorized control	
	Demand control	CO <sub>2</sub> sensors	CO <sub>2</sub> sensors	
Ducts	Friction rate	0.08 in. w.c. / 100 feet	No recommendation	
	Sealing	Seal class B	Seal class C	
	Location	Interior only	No recommendation	
	Insulation level	R-6	R-6	
Service Water Heater	Gas storage	90% E <sub>t</sub>	(0.62 – 0.0019V)	
	Gas instantaneous	0.81 EF or 81% E <sub>t</sub>	(0.62 – 0.0019V)	

	Electric storage 12 kW	$EF > 0.99 - 0.0012 * \text{Volume}$	$EF > 0.93 - 0.0032V$
	Pipe insulation (d < 1 1/2 in / d > 1 1/2 in)	1 in. / 1 1/2 in.	1/2 in. / 1 in

**Climate Zone 1 and 2 Recommendation Table: AADG - K-12 School Buildings**

Item	Component	Recommendation	ASHRAE 90.1 2004	
Roof	Insulation entirely above deck	R-25 c.i.	R-15 c.i.	
	Metal building	R-19	R-19	
	Attic and other	R-30	R-30	
	Single rafter	R-30	R-30	
	Surface reflectance	0.78	No recommendation	
Walls	Mass (HC>7 Btu/ft <sup>2</sup> )	R-5.7 c.i.	No recommendation	
	Metal building	R-16	R-13	
	Steel framed	R-13	R-13	
	Wood framed and other	R-13	R-13	
	Below-grade walls	No recommendation	No recommendation	
Floors	Mass	R-4.2 c.i.	No recommendation	
	Steel framed	R-19	No recommendation	
	Wood framed and other	R-19	No recommendation	
Slabs	Unheated	No recommendation	No recommendation	
	Heated	R-7.5 for 12 in.	R-7.5 for 12 in.	
Doors	Swinging	U-0.70	No recommendation	
	Non-swinging	U-1.45	No recommendation	
Vert. Glazing	Window to wall ratio (WWR)	35% maximum	40% maximum	
	Thermal transmittance	U-0.56	Fixed	Operable
			U-1.22	U-1.27
	SHGC – all types and orientation	SHGC – 0.25	0.25 all / 0.61 North	
	Exterior sun control (S, E, W only)	Projection factor (PF) 0.5	Based on PF	
Int. Finishes	Interior room surface average reflectance	70%+ on ceilings and walls above 7 ft 50%+ on walls below 7 ft	No recommendation	
Interior Lighting- Daylighting option	Classroom daylighting (daylighting fenestration to floor area ratio)	Toplighted – South-facing roof monitors: 8% - 11% North-facing roof monitors: 12%-15%	No recommendation	
		Sidelighted- South-facing: 8% - 11% North-facing: 15%-20%		
		Combined tiplighted and sidelighted- Southfacing sidelighted: 6% - 8% Toplighted: 2% - 3% Northfacing sidelighted: 9% - 13% Toplighted: 3% - 5%		
	Gym toplighting (daylighting fenestration to floor area ratio)	South-facing roof monitors: 5% - 8% North-facing roof monitors: 7% -10%	No recommendation	
	Lighting power density (LPD)	1.2 W/ ft <sup>2</sup>	1.0 W/ ft <sup>2</sup>	
	Light source system efficacy (linear fluorescent)	75 mean lm/W minimum	No recommendation	
	Light source system efficacy (all other sources)	50 mean lm/W minimum	No recommendation	
	Occupancy controls	Manual on, auto, off all zones	No recommendation	
Dimming controls daylight harvesting	Dim all fixtures in classrooms and gym and other fixtures within 15 ft of sidelighting edge and within 10 ft of toplighting edge	No recommendation		
Interior Lighting- Non- Daylighting option	Lighting power density (LPD)	1.1 W/ ft <sup>2</sup>	No recommendation	
	Light source system efficacy (linear fluorescent)	85 mean lm/W minimum		
	Light source system efficacy (all other sources)	50 mean lm/W minimum		
	Occupancy controls	Manual on, auto, off all zones		
	Dimming controls daylight	Dim fixtures within 15 ft of sidelighting		

	harvesting	edge and within 10 ft of toplighting edge	
Packaged DX Rooftops (or DX Split Systems)	Air conditioner (0-65 kBtu/h)	13.0 SEER	12.0 SEER
	Air conditioner (>65-135 kBtu/h)	11.3 EER	10.3 EER
	Air conditioner (>135-240 kBtu/h)	11.0 EER	9.7 EER
	Air conditioner (>240 kBtu/h)	10.6 EER / 11.2 IPLV	9.5 EER / 9.7 IPLV
	Heat pump (0-65 kBtu/h)	13 SEER / 7.7 HSPF	12 SEER / 7.4 HSPF
	Heat pump (>65-135 kBtu/h)	10.6 EER / 3.2 COP	10.1 EER / 3.2 COP
	Heat pump (>135 kBtu/h)	10.1 EER / 11.5 IPLV / 3.1 COP	9.5 EER / 3.1 COP
	Gas furnace (<225 kBtu/h)	80% AFUE or $E_t$	78% AFUE or 80% $E_t$
	Gas furnace (>225 kBtu/h)	80% $E_c$	80% $E_c$
	Economizer	Comply with ASHRAE 90.1	No recommendation
	Ventilation	Energy recovery or demand control	No recommendation
Fans	Constant volume: 1 hp/1000 cfm Variable volume: 1.3 hp/1000 cfm	C vol: 1.1 hp/1000 cfm V vol 1.5 hp/1000 cfm	
WSHP System	Water source heat pump (<65 KBtu/h)	Cooling: 12 SEER at 86 °F Heating: 4.5 COP at 68 °F	Clg: 12 SEER at 86 °F Htg: 4.5 COP at 68 °F
	Water source heat pump (≥65 KBtu/h)	Cooling: 12 SEER at 86 °F Heating: 4.2 COP at 68 °F	Clg: 12 SEER at 86 °F Htg: 4.2 COP at 68 °F
	Ground source heat pump (GSHP) (<65 kBtu/h)	Clg: 14.1 EER at 77°F, 17 EER at 59°F Htg: 3.5 COP at 32°F, 4.0 COP at 50°F	Clg: 13.4 EER at 77°F, Htg: 3.5 COP at 32°F, 4.0 COP at 50°F
	GSHP (65 ≥ kBtu/h)	Clg: 13 EER at 77°F, 16 EER at 59°F Htg: 3.1 COP at 32°F, 3.5 COP at 50°F	Clg: 13.4 EER at 77°F, Htg: 3.1 COP at 32°F
	Gas boiler	85% $E_c$	80% $E_c$
	Economizer	Comply with ASHRAE 90.1	No recommendation
	Ventilation	Energy recovery or demand control	No recommendation
WSHP duct pressure drop	Total ESP < 0.2 in. H <sub>2</sub> O	No recommendation	
Fan Coil and Chiller System	Air-cooled chiller efficiency	10.0 EER and 11.5 IPLV	No recommendation
	Water-cooled chiller efficiency	Comply with ASHRAE 90.1	4.2 COP, 5.05 IPLV
	Gas boiler	80% $E_c$	80% $E_c$
	Economizer	Comply with ASHRAE 90.1	No recommendation
	Ventilation	DOAS with either energy recovery or demand control	No recommendation
	Pressure drop	Total ESP < 0.2 in. H <sub>2</sub> O	No recommendation
Packaged Rooftop VAV System	Rooftop air conditioner (≥240 kBtu/h)	10.0 EER and 11.2 IPLV	9.5 EER, 9.7 IPLV
	Gas furnace (≥225 kBtu/h)	80% $E_c$	80% $E_c$
	Gas boiler	80% $E_c$	80% $E_c$
	Economizer	Comply with ASHRAE 90.1	No recommendation
	Ventilation	DOAS with either energy recovery or demand control	No recommendation
	Pressure drop	Total ESP < 0.2 in. H <sub>2</sub> O	No recommendation
VAV and Chiller System	Air-cooled chiller efficiency	10.0 EER and 11.5 IPLV	No recommendation
	Water-cooled chiller efficiency	Comply with ASHRAE 90.1	4.2 COP, 5.05 IPLV
	Gas boiler	80% $E_c$	80% $E_c$
	Economizer	Comply with ASHRAE 90.1	No recommendation
	Ventilation	Energy recovery or demand control	No recommendation
Ducts and Dampers	Outdoor air damper	Motorized	Motorized
	Friction rate	0.08 in. w.c. / 100 feet	No recommendation
	Sealing	Seal class B	Seal class C
	Location	Interior only	No recommendation
	Insulation level	R-6	R-6
Service Water Heater	Gas storage	90% $E_t$	90% $E_t(Q/800+\sqrt{110V})$
	Gas instantaneous	0.81 EF or 81% $E_t$	90% $E_t(Q/800+\sqrt{110V})$
	Electric storage 12 kW	EF > 0.99 – 0.0012*Volume	EF > 0.93 – 0.0032V
	Pipe insulation (d<1 ½ in/d >1 ½ in)	1 in. / 1 ½ in.	½ in. / 1 in