ANSI/ASHRAE/IES Addenda bx, by, ca, cb, and cc to
ANSI/ASHRAE/IESNA Standard 90.1-2007

ASHRAE ADDENDA

Energy Standard for Buildings Except Low-Rise Residential Buildings

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FOREWORD

This addendum supplements changes made in addendum-h and addendum-as to 90.1-2007. It is also attempting to bring into alignment requirements of 90.1 and 62.1. By limiting the reheat supply air temperature from ceiling supply air devices, better room air distribution effectiveness will be achieved and short circuiting of air into ceiling return air inlets will be reduced (limiting energy loss). This addendum is promoting alternative methods of heating perimeter spaces with high heat losses other than the use of a VAV box with terminal reheat (i.e. radiant heat, parallel fan powered box, etc.).

Note: *This addendum contains language that has been modified in addenda "h" and "as" to 90.1-2007.*

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum bx to 90.1-2007

Revise the Standard as follows (I-P units).

6.5.2.1 Zone Controls. *Zone* thermostatic controls shall ~~be capable of operating in sequence the supply of heating and cooling energy to the *zone*. Such controls shall~~ prevent

1. *reheating*,
2. *recooling*,
3. mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer systems, and
4. other simultaneous operation of heating and cooling systems to the same *zone*.

Exceptions to 6.5.2.1:

a. Zones for which the volume of air that is reheated, recooled, or mixed does not exceed the largest of the following:

   1. 30% of the zone design peak supply rate,
   2. The *outdoor air* flow rate required to meet the ventilation requirements of Section 6.2 of ASHRAE Standard 62.1 for the *zone*,
   3. Any higher rate that can be demonstrated, to the satisfaction of the *authority having jurisdiction*, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in *outdoor air* intake.
   4. The air flow rate required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.

b. Zones that comply with all of the following:

   1. The air flow rate ~~that is reheated, recooled, or mixed~~ in *dead band* between heating and cooling does not exceed the largest of the following:
      a. 20% of the zone design peak supply rate,
      b. the *outdoor air* flow rate required to meet the ventilation requirements of Section 6.2 of ASHRAE Standard 62.1 for the *zone*,
      c. any higher rate that can be demonstrated, to the satisfaction of the *authority having jurisdiction*, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in *outdoor air* intake.
   2. The air flow rate that is reheated, recooled, or mixed does not exceed 50% of the zone design peak supply rate
   3. Airflow between *dead band* and full heating or full cooling shall be modulated.

c. Laboratory exhaust systems that comply with 6.5.7.2.

d. *Zones* where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a *site-recovered* (including condenser heat) or *site- solar energy source.*

6.5.2.1.1 Supply Air Temperature Reheat Limit: Where *reheating* is permitted by other parts of this standard, *zones* that have both supply and return/exhaust air openings greater than 6 feet above floor shall not supply heating air more than 20ºF above the space temperature setpoint.

Exceptions to 6.5.2.1.1:

a. Laboratory exhaust systems that comply with 6.5.7.2.
b. During preoccupancy building warm-up and *setback*

Revise the Standard as follows (S-I units).

6.5.2.1 Zone Controls. *Zone* thermostatic controls shall ~~be capable of operating in sequence the supply of heating and cooling energy to the *zone*. Such controls shall~~ prevent

1. *reheating*,
2. *recooling*,
3. mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer systems, and
4. other simultaneous operation of heating and cooling systems to the same *zone*.

Exceptions to 6.5.2.1:

a. Zones for which the volume of air that is reheated, recooled, or mixed does not exceed the largest of the following:

1. 30% of the zone design peak supply rate,
2. The *outdoor air* flow rate required to meet the ventilation requirements of Section 6.2 of ASHRAE Standard 62.1 for the *zone*,
3. Any higher rate that can be demonstrated, to the satisfaction of the *authority having jurisdiction*, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in *outdoor air* intake.
4. The air flow rate required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.

b. Zones that comply with all of the following:

1. The air flow rate ~~that is reheated, recooled, or mixed~~ in *dead band* between heating and cooling does not exceed the largest of the following:
   a. 20% of the zone design peak supply rate,
   b. the *outdoor air* flow rate required to meet the ventilation requirements of Section 6.2 of ASHRAE Standard 62.1 for the *zone*,
   c. any higher rate that can be demonstrated, to the satisfaction of the *authority having jurisdiction*, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in *outdoor air* intake.
2. The air flow rate that is reheated, recooled, or mixed does not exceed 50% of the zone design peak supply rate
3. Airflow between *dead band* and full heating or full cooling shall be modulated.

c. Laboratory exhaust systems that comply with 6.5.7.2.

d. *Zones* where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a *site-recovered* (including condenser heat) or *site- solar energy source.*

<u>**6.5.2.1.1 Supply Air Temperature Reheat Limit:** Where *reheating* is permitted by other parts of this standard, *zones* that have both supply and return/exhaust air openings greater than 2 m above floor shall not supply heating air more than 11.1°C above the space temperature setpoint.</u>

<u>**Exceptions to 6.5.2.1.1:**</u>

<u>a. Laboratory exhaust systems that comply with 6.5.7.2.</u>

<u>b. During preoccupancy building warm-up and *setback*</u>

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

The Lighting Power Density (LPD) values in the 90.1 standard have not been updated since the 2007 version even though technology has advanced and lighting design best practice has also changed. Issues have also been raised with the use of the lumen method as the calculation base for the models without more advanced modeling verification of its applicability to all space types. This revision proposal represents a complete review, update, correction, and restructuring of the modeling and calculation basis for the space type and resulting whole building type LPDs. All of the 96 space type models that form the 90.1 space LPDs in the standards and an additional set of approximately 20 models used in whole building LPD development were reviewed and updated as follows:

Fixture type efficiency (CU) – The luminaire characteristics used in the models including the important Coefficient of Utilization (CU) at various Room Cavity Ratio (RCR) configurations have not been completely updated with the latest available technology since early 2000.

- *A complete review of this data that supports close to 40 luminaire types used in the models was updated in summer 2009. Additional luminaire types were also added where needed to reflect current design applications.*

Lamp/ballast efficacies – Lamp and ballast combination as well as non-ballast driven lamp efficacies have not been updated since 2004.

- *The efficacy value applied in the models for the commonly used linear fluorescent light source type has been revised to reflect current instant start efficient ballast and series 800 advanced efficiency lamps.*

Room geometry configuration for spaces - The number of Room Geometry (RCR) categories assignable to different space types was previously only three (1,5,7) with larger than reasonable gaps between. Some categories were previously miss-applied due to insufficient data to identify correct category and odd room configurations had no method of adjusting LPD allowance to accommodate.

- *Building space data analysis of data collected from multiple new construction buildings was used to identify more correct RCR assignments based on more even 2,4,6,8,10, set of RCR categories.*
- *RCRs were reviewed and assigned to match most common spaces.*
- *The need for variances has typically been considered to be a simple ceiling height issue but with the collected building data and analysis, it was determined to vary too much by simple ceiling height and more accurately a complete RCR related issue.*
- *AGI modeling was used to verify the validity of an added adjustment factor for irregular spaces based on a threshold of RCR above the common RCR for each space type.*

Previously, vertical lighting from Wall Wash applications was crudely applied due to the lack of CU data for these applications.

- *AGI modeling was used to determine the relationship between typical wall wash applications and the resulting overall horizontal space LPD contribution at various RCR configurations and equipment types. The data showed correlation for applications separately for each RCR category as shown in Figure 1:*

Obstruction issue – Obstructions in certain space types (i.e. library stacks, restroom stalls, high office partitions, warehouse shelves) are difficult when applying lumen method

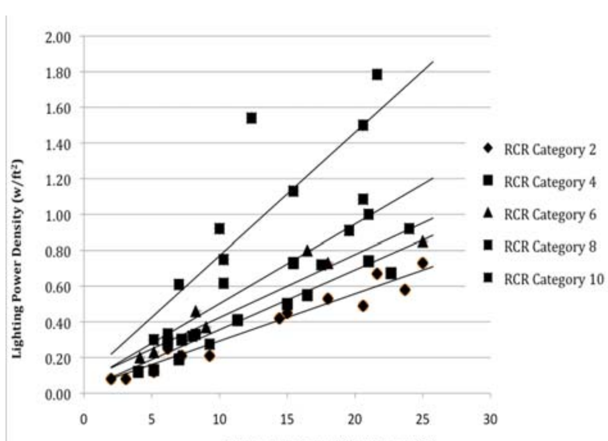

Figure 1 RCR Correlation.

calculations without additional impractical assessment of individual space obstructions.

- *AGI modeling was used to develop an understanding of the need for adjusted LPD in these cases and an adjustment factor developed to be applied only when obstructions would adversely affect light distribution.*
- *Application of the adjustment is restricted to groups of obstructions that meet light blockage characteristics related to obstruction height and proximity to other obstructions and walls:*

Task and General light levels assigned to models based on IES recommendations - Previous assignments of task and general lighting was not specifically tied to the specific luminaires used in design causing high or low LPD errors.

- *AGI modeling was used to identify the commonly used models where this more arbitrary assignment created impractical model designs.*
- *Light levels have been reassigned to the specific model luminaires creating LPD models that are reality based and work in real application to develop more realistic LPD allowances.*

Results of proposed model changes:

- *Most LPDs will go down (62 of the space type models) for energy savings based on:*
  - *higher equipment efficacy*
  - *More accurate understanding of space geometry*
- *Some LPDs will go up (16 of the space type models) for increased energy*
  - *Necessary to correct model inaccuracies associated with tightened LPDs*
  - *Some space LPDs with remain approximately the same as before (9)*
  - *PRELIMINARY Rough Estimate of overall US weighted average savings is up to 17% of building lighting energy only.*

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum by to 90.1-2007

Revise the Standard as follows (I-P units)

Revise Section 3.2 Definition as follows:

Room Cavity Ratio (RCR): a factor that characterizes room configuration as a ratio between the walls and ceiling and is based on room dimensions~~.~~ as follows:

Revise table 9.5.1 as follows:

TABLE 9.5.1 Lighting Power Densities Using the Building Area Method

Building Area Type[a]	LPD (W/ft^2)
Automotive facility	0.82 ~~0.9~~
Convention center	1.08 ~~1.2~~
Courthouse	1.05 ~~1.2~~
Dining: bar lounge/leisure	0.99 ~~1.3~~
Dining: cafeteria/fast food	0.90 ~~1.4~~
Dining: family	0.89 ~~1.6~~
Dormitory	0.61 ~~1.0~~
Exercise center	0.88 ~~1.0~~
Fire station	0.71
Gymnasium	1.00 ~~1.1~~
Health-care clinic	0.87 ~~1.0~~
Hospital	1.21 ~~1.2~~
Hotel	1.00 ~~1.0~~
Library	1.18 ~~1.3~~
Manufacturing facility	1.11 ~~1.3~~
Motel	0.88 ~~1.0~~
Motion picture theater	0.83 ~~1.2~~
Multifamily	0.60 ~~0.7~~
Museum	1.06 ~~1.1~~
Office	0.90 ~~1.0~~
Parking garage	0.25 ~~0.3~~
Penitentiary	0.97 ~~1.0~~
Performing arts theater	1.39 ~~1.6~~
Police~~/fire~~ station	0.96 ~~1.0~~
Post office	0.87 ~~1.1~~
Religious building	1.05 ~~1.3~~
Retail	1.40 ~~1.5~~
School/university	0.99 ~~1.2~~
Sports arena	0.78 ~~1.1~~
Town hall	0.92 ~~1.1~~
Transportation	0.77 ~~1.0~~
Warehouse	0.66 ~~0.8~~
Workshop	1.20 ~~1.4~~

[a]In cases where both a general building area type and a specific building area type are listed, the specific building area type shall apply.

Delete the existing Table 9.6.1 and replace it as follows (the deletion of the old table is not shown)

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Common Space Types[a]	LPD, W/ft^2	RCR Threshold
Atrium		
First 40 ft in height	0.03 per ft (height)	NA
Height above 40 ft	0.02 per ft (height)	NA
Audience/Seating Area		
Permanent for auditorium	0.79	6
For Performing Arts Theater	2.43	8
For Motion Picture Theater	1.14	4
Classroom/Lecture/Training	1.24	4
Conference/Meeting/Multipurpose	1.23	6
Corridor/Transition	0.66	Width<8 ft
Dining Area	0.65	4
For Bar Lounge/Leisure Dining	1.31	4
For Family Dining	0.89	4
Dressing/Fitting Room for Performing Arts Theater	0.40	6
Electrical/Mechanical	0.95	6
Food Preparation	0.99	6
Laboratory		
For Classrooms	1.28	6
For Medical/Industrial/Research	1.81	6
Lobby	0.65	4
For Performing Arts Theater	2.00	6
For Motion Picture Theater	0.52	4
Locker Room	0.75	6
Lounge/Recreation	0.73	4
Office		
Enclosed	1.11	8
Open Plan	0.98	4
Restrooms	0.98	8
Sales Area (for accent lighting, see Section 9.6.2(b))	1.68	6
Stairway	0.69	10
Storage	0.63	6
Workshop	1.59	6
Automotive		
Service/Repair	0.67	4

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Bank/Office		
Banking Activity Area	1.38	6
Convention Center		
Audience Seating	0.82	4
Exhibit Space	1.45	4
Courthouse/Police Station/Penitentiary		
Courtroom	1.72	6
Confinement Cells	1.10	6
Judges' Chambers	1.17	8
Penitentiary Audience Seating	0.43	4
Penitentiary Classroom	1.34	4
Penitentiary Dining	1.07	6
Dormitory		
Living Quarters	0.38	8
Fire Stations		
Engine Room	0.56	4
Sleeping Quarters	0.25	6
Gymnasium/Fitness Center		
Fitness Area	0.72	4
Fitness Center Audience Seating	0.20	4
Gymnasium Audience Seating	0.43	6
Playing Area	1.20	4
Hospital		
Corridor/Transition	0.89	Width < 8 ft
Emergency	2.26	6
Exam/Treatment	1.66	8
Laundry/Washing	0.60	4
Lounge/Recreation	1.07	6
Medical Supply	1.27	6
Nursery	0.88	6
Nurses' Station	0.87	6
Operating Room	1.89	6
Patient Room	0.62	6
Pharmacy	1.14	6
Physical Therapy	0.91	6
Radiology/Imaging	1.32	6
Recovery	1.15	6
Hotel/Motel		
Hotel Dining	0.82	4
Hotel Guest Rooms	1.11	6
Hotel Lobby	1.06	4

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Building-Specific Space Types	*LPD*, W/ft^2	RCR Threshold
Highway Lodging Dining	0.88	4
Highway Lodging Guest Rooms	0.75	6
Library		
Card File and Cataloging	0.72	4
Reading Area	0.93	4
Stacks	1.71	4
Manufacturing		
Corridor/Transition	0.41	Width < 8 ft
Detailed Manufacturing	1.29	4
Equipment Room	0.95	6
Extra High Bay (>50 ft Floor to Ceiling Height)	1.05	4
High Bay (25–50 ft Floor to Ceiling Height)	1.23	4
Low Bay (<25 ft Floor to Ceiling Height)	1.19	4
Museum		
General Exhibition	1.05	6
Restoration	1.02	6
Parking Garage		
Garage Area	0.19	4
Post Office		
Sorting Area	0.94	4
Religious Buildings		
Audience Seating	1.53	4
Fellowship Hall	0.64	4
Worship Pulpit, Choir	1.53	4
Retail		
Dressing/Fitting Room	0.87	8
Mall Concourse	1.10	4
Sales Area (for accent lighting, see Section 9.6.3(c))	1.68	6
Sports Arena		
Audience Seating	0.43	4
Court Sports Arena—Class 4	0.72	4
Court Sports Arena—Class 3	1.20	4
Court Sports Arena—Class 2	1.92	4
Court Sports Arena—Class 1	3.01	4
Ring Sports Arena	2.68	4
Transportation		
Air/Train/Bus—Baggage Area	0.76	4
Airport—Concourse	0.36	4
Terminal—Ticket Counter	1.08	4
Warehouse		
Fine Material Storage	0.95	6
Medium/Bulky Material Storage	0.58	4

[a] In cases wher eboth a common space type and a building-specific type are listed, the building specific space type shall apply.

Add exception q to Section 9.2.2.3:

q. Mirror lighting in dressing rooms and accent lighting in religious pulpit and choir areas.

Modify section 9.6.2a as follows:

For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance~~, such as chandalicar type luminaires,~~ or for highlighting art or exhibits, provided that the additional power shall not exceed 1.0 W/ft^2 of such spaces.

Add new section to describe the adjustments as follows:

9.6.3 Room Geometry Adjustment. When using the space by space method, an adjustment of the space LPD is allowed for individual spaces where:
the *Room Cavity Ratio* (RCR) calculated for the empty room is documented to be greater than the RCR threshold for that space type shown in Table 9.6.1.

RCR = 2.5 × Room Cavity Height × room perimeter length/room area

Where:

Room Cavity Height = Luminaire mounting height – Workplane

For corridor/transition spaces, this adjustment is allowed when the corridor is less than 8 feet wide, regardless of the RCR.

The LPD allowance for these spaces may be increased by the following amount:

LPD increase = Base space LPD × 0.20

Where:

Base space LPD = the applicable LPD from Table 9.6.1.

Revise the Standard as follows (SI units)

Revise Section 3.2 Definition as follows:

Room Cavity Ratio (RCR): a factor that characterizes room configuration as a ratio between the walls and ceiling and is based on room dimensions~~.~~ as follows:

Revise Table 9.5.1 as follows:

TABLE 9.5.1 Lighting Power Densities Using the Building Area Method

Building Area Type[a]	LPD (W/m^2)
Automotive facility	~~10~~ 8.8
Convention center	~~13~~ 11.6
Courthouse	~~13~~ 11.3
Dining: bar lounge/leisure	~~14~~ 10.7
Dining: cafeteria/fast food	~~15~~ 9.7
Dining: family	~~17~~ 9.6
Dormitory	~~11~~ 6.6
Exercise center	~~11~~ 9.5
Fire station	7.6
Gymnasium	~~12~~ 10.8
Health-care clinic	~~11~~ 9.4
Hospital	~~13~~13.0
Hotel	~~11~~ 10.8
Library	~~14~~ 12.7
Manufacturing facility	~~14~~11.9
Motel	~~11~~ 9.5
Motion picture theater	~~13~~ 8.9
Multifamily	~~8~~ 6.5
Museum	~~12~~ 11.4
Office	~~11~~9.7
Parking garage	~~3~~ 2.7
Penitentiary	~~11~~ 10.4
Performing arts theater	~~17~~ 15.0
Police~~/fire~~ station	~~11~~ 10.3
Post office	~~12~~ 9.4
Religious building	~~14~~11.3
Retail	~~16~~15.1
School/university	~~13~~10.7
Sports arena	~~12~~ 8.4
Town hall	~~12~~ 9.9
Transportation	~~11~~ 8.3
Warehouse	~~9~~ 7.1
Workshop	~~15~~ 2.9

[a]In cases where both a general building area type and a specific building area type are listed, the specific building area type shall apply.

Delete the existing Table 9.6.1 and replace it as follows (the deletion of the old table is not shown)

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Common Space Types[a]	LPD, W/m²	RCR Threshold
Atrium		
First 13 m in height	0.10 per m (height)	NA
Height above 13 m	0.07 per m (height)	NA
Audience/Seating Area		
Permanent for auditorium	8.5	6
For Performing Arts Theater	26.2	8
For Motion Picture Theater	12.3	4
Classroom/Lecture/Training	13.3	4
Conference/Meeting/Multipurpose	13.2	6
Corridor/Transition	7.1	Width< 2.4 m
Dining Area	7.0	4
For Bar Lounge/Leisure Dining	14.1	4
For Family Dining	9.6	4
Dressing/Fitting Room for Performing Arts Theater	4.3	6
Electrical/Mechanical	10.2	6
Food Preparation	10.7	6
Laboratory	13.8	6
For Classrooms	13.8	6
For Medical/Industrial/Research	19.5	6
Lobby	7.0	4
For Performing Arts Theater	21.5	6
For Motion Picture Theater	5.6	4
Locker Room	8.1	6
Lounge/Recreation	7.9	4
Office		
Enclosed	11.9	8
Open Plan	10.5	4
Restrooms	10.5	8
Sales Area (for accent lighting, see Section 9.6.2(b))	18.1	6
Stairway	7.4	10
Storage	6.8	6
Workshop	17.1	6

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Building-Specific Space Types	*LPD*, W/ft²	RCR Threshold
Automotive		
Service/Repair	7.2	4
Bank/Office		
Banking Activity Area	14.9	6
Convention Center		
Audience Seating	8.8	4
Exhibit Space	15.6	4
Courthouse/Police Station/Penitentiary		
Courtroom	18.5	6
Confinement Cells	11.8	6
Judges' Chambers	12.6	8
Penitentiary Audience Seating	4.6	4
Penitentiary Classroom	14.4	4
Penitentiary Dining	11.5	6
Dormitory		
Living Quarters	4.1	8
Fire Stations		
Engine Room	6.0	4
Sleeping Quarters	2.7	6
Gymnasium/Fitness Center		
Fitness Area	7.8	4
Fitness Center Audience Seating	2.2	4
Gymnasium Audience Seating	4.6	6
Playing Area	12.9	4
Hospital		
Corridor/Transition	9.6	Width < 8 ft
Emergency	24.3	6
Exam/Treatment	17.9	8
Laundry/Washing	6.5	4
Lounge/Recreation	11.5	6
Medical Supply	13.7	6
Nursery	9.5	6
Nurses' Station	9.4	6
Operating Room	20.3	6
Patient Room	6.7	6
Pharmacy	12.3	6
Physical Therapy	9.8	6
Radiology/Imaging	14.2	6

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Building-Specific Space Types	*LPD*, W/ft^2	RCR Threshold
Recovery	12.4	6
Hotel/Motel		
Hotel Dining	8.8	4
Hotel Guest Rooms	11.9	6
Hotel Lobby	11.4	4
Highway Lodging Dining	9.5	4
Highway Lodging Guest Rooms	8.1	6
Library		
Card File and Cataloging	7.8	4
Reading Area	10	4
Stacks	18.4	4
Manufacturing		
Corridor/Transition	4.4	Width < 2.4 m
Detailed Manufacturing	13.9	4
Equipment Room	10.2	6
Extra High Bay (>15.2 m Floor to Ceiling Height)	11.3	4
High Bay (7.6–15.2 m Floor to Ceiling Height)	13.2	4
Low Bay (<7.6 m Floor to Ceiling Height)	12.8	4
Museum		
General Exhibition	11.3	6
Restoration	11.0	6
Parking Garage		
Garage Area	2.0	4
Post Office		
Sorting Area	10.1	4
Religious Buildings		
Audience Seating	16.5	4
Fellowship Hall	6.9	4
Worship Pulpit, Choir	16.5	4
Retail		
Dressing/Fitting Room	9.4	8
Mall Concourse	11.8	4
Sales Area (for accent lighting, see Section 9.6.3(c))	18.1	6
Sports Arena		
Audience Seating	4.6	4
Court Sports Arena—Class 4	7.8	4
Court Sports Arena—Class 2	20.7	4
Court Sports Arena—Class 1	32.4	4
Ring Sports Arena	28.8	4
Transportation		
Air/Train/Bus—Baggage Area	8.2	4
Airport—Concourse	3.9	4
Audience Seating	5.8	4
Terminal—Ticket Counter	11.6	4
Warehouse		
Fine Material Storage	10.2	6
Medium/Bulky Material Storage	6.2	4

[a] In cases wher eboth a common space type and a building-specific type are listed, the building specific space type shall apply.

Add exception q to Section 9.2.2.3:

q. Mirror lighting in dressing rooms and accent lighting in religious pulpit and choir areas.

Modify section 9.6.2a as follows:

For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance~~, such as chandaliear type luminaires,~~ or for highlighting art or exhibits, provided that the additional power shall not exceed 10.8 W/m^2 of such spaces.

Add new section to describe the adjustments as follows:

9.6.3 Room Geometry Adjustment. When using the space by space method, an adjustment of the space LPD is allowed for individual spaces where:
the *Room Cavity Ratio* (RCR) calculated for the empty room is documented to be greater than the RCR threshold for that space type shown in Table 9.6.1.

$$RCR = 2.5 \times \text{Room Cavity Height} \times \text{room perimeter length} / \text{room area}$$

Where:

Room Cavity Height
= Luminaire mounting height – Workplane

For corridor/transition spaces, this adjustment is allowed when the corridor is less than 2.4m wide, regardless of the RCR.

The LPD allowance for these spaces may be increased by the following amount:

$$\text{LPD increase} = \text{Base space LPD} \times 0.20$$

Where:

Base space LPD = the applicable LPD from Table 9.6.1.

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FOREWORD

This change closes a loophole in the fan power allowances for Variable Air Volume (VAV) systems. Standard VAV systems are multi-zone systems with terminal units containing control dampers to vary airflow to individual zones. Currently a higher fan power allowance is given to these systems based on the need to overcome the added pressure drop through these terminal units. A VAV system without terminal units (typically serving a single zone) does not need this added fan power allowance and should reasonably comply with the constant volume fan power requirements.

Note: In this addendum, changes to the current standard are indicated in the text by <u>underlining</u> (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum ca to 90.1-2007

Revise the Standard as follows (I-P units)

6.5.3.1.1 Each HVAC system at fan system design conditions shall not exceed the allowable *fan system motor nameplate hp* (Option 1) or *fan system bhp* (Option 2) as shown in Table 6.5.3.1.1A. This includes supply fans, return/relief fans, exhaust fans, and fan-powered terminal units associated with systems providing heating or cooling capability. <u>Single zone variable-air-volume systems shall comply with the constant volume fan power limitation.</u>

Revise the Standard as follows (S-I units)

6.5.3.1.1 Each HVAC system at fan system design conditions shall not exceed the allowable *fan system motor nameplate kW* (Option 1) or *fan system input kW* (Option 2) as shown in Table 6.5.3.1.1A. This includes supply fans, return/relief fans, exhaust fans, and fan-powered terminal units associated with systems providing heating or cooling capability. <u>Single zone variable-air-volume systems shall comply with the constant volume fan power limitation.</u>

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

This addendum includes a number of changes which are described below.

1. ***Require simple systems to meet prescriptive outdoor air damper requirements.*** *This removes the damper requirements found in the Simplified Approach and instead requires simple systems to meet the shutoff damper requirements found in the Prescriptive Path, making these two approaches more consistent.*
2. ***Allows backdraft dampers only for exhaust and relief dampers in buildings less than three stories in height.*** *Currently, buildings less than 3 stories in height are allowed backdraft dampers since the temperature driven pressure differential (stack effect) is not great enough on a short building to open most backdraft dampers. This makes sense for exhaust and relief dampers which open outwards. However, outdoor air intake dampers open inwards and stack effect will not push the damper open. For this reason, it makes little sense to have a different requirement for outdoor air intakes on short buildings verses tall buildings. For a building of any height, wind can push open a gravity damper which opens inwards. and an automatic damper on an air intake will prevent that. Also, with a gravity damper on an outdoor air intake, whenever the HVAC system runs during night setback operation or morning warmup, the damper will be bringing in unneeded outdoor air. An automatic damper enables the outdoor air intake to be closed during morning warmup and night setback operation.*
3. ***Require backdraft dampers on outdoor air intakes to be protected from wind limiting wind blown infiltration through the damper.***
4. ***Move climate zone 5a to the category of climates that require low leak dampers.*** *This change was justified by a cost effectiveness analysis.*
5. ***Correct a mistake in Table 6.4.3.4.4*** *During a previous revision to this table, a footnote allowing small dampers (less than 24 inches in any direction) in climate zones 1, 2, 5a, 6, 7, and 8 to have higher leakage rates was inadvertently dropped. This change fixes that mistake.*
6. ***Reformat the table 6.4.3.4.4 for clarity.***

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.A

Addendum cb to 90.1-2007

Modify the Standard as follows (I-P Units).

6.3 Simplified Approach Option for HVAC Systems

6.3.2 Criteria. The HVAC *system* must meet ALL of the following criteria:

...

c. The *system* shall have an air economizer where indicated in Table 6.5.1, with controls as indicated in Tables 6.5.1.1.3A and 6.5.1.1.3B and with either barometric or powered relief sized to prevent overpressurization of the building. Where the cooling *efficiency* meets or exceeds the *efficiency* requirement in Table 6.3.2, no economizer is required. ~~*Outdoor air* dampers for economizer use shall be provided with blade and jamb seals.~~

...

n. ~~Exhausts with a design capacity of over 300 cfm on *systems* that do not operate continuously shall be equipped with gravity or motorized dampers that will automatically shut when the *systems* are not in use~~ Outdoor air intake and exhaust systems shall meet the requirements of Section 6.4.3.4.

...

6.4.3.4.32 Shutoff Damper Controls. All *outdoor air* intake and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use. Ventilation *outdoor air* and exhaust/relief dampers shall be capable of automatically shutting off during preoccupancy building warm-up, cool down, and *setback,* except when *ventilation* reduces energy costs or when ventilation must be supplied to meet code requirements.

Exceptions:

a. Backdraft gravity (nonmotorized) dampers are acceptable for exhaust and relief dampers in buildings less than three stories in height and for ventilation air intakes and exhaust and relief dampers in buildings of any height located in climate zones 1, 2, and 3. Backdraft dampers for ventilation air intakes must be protected from direct exposure to wind.

6.4.3.4.3 Dampers Leakage. Where *outdoor air* supply and exhaust/relief dampers are required by Section 6.4.3.4, they shall have a maximum leakage rate when tested in accordance with AMCA Standard 500 as indicated in Table 6.4.3.4.3.

~~**TABLE 6.4.3.4.3 Maximum Damper Leakage**~~

~~Climate Zones~~	~~Maximum Damper Leakage at 1.0 in. w.g. cfm per ft^2 of damper area~~	
	~~Motorized~~	~~Nonmotorized (where permitted)[a]~~
~~1, 2, 6, 7, 8~~	4	~~20~~
~~3,4, 5~~	~~10~~	~~20[a]~~

~~[a] Dampers smaller than 24 in.(0.6 m) in either dimension may have leakage of 40 cfm/ft^2~~

TABLE 6.4.3.4.3 Maximum Damper Leakage (cfm per ft^2) at 1.0 in. w.g.

Climate Zone	Ventilation Air Intake		Exhaust/Relief	
	non-motorized[1]	motorized	non-motorized[1]	motorized
1,2	-	-	-	-
any height	20	4	20	4
3	-	-	-	-
any height	20	10	20	10
4,5b,5c	-	-	-	-
less than 3 stories	not allowed	10	20	10
3 or more stories	not allowed	10	not allowed	10
5a,6,7,8	-	-	-	-
less than 3 stories	not allowed	4	20	4
3 or more stories	not allowed	4	not allowed	4

[1] Dampers smaller than 24 in. in either dimension may have leakage of 40 cfm/ft^2.

Revise the Standard as follows (SI units)

6.3 Simplified Approach Option for HVAC Systems

6.3.2 Criteria. The HVAC *system* must meet ALL of the following criteria:

...

c. The *system* shall have an air economizer where indicated in Table 6.5.1, with controls as indicated in Tables 6.5.1.1.3A and 6.5.1.1.3B and with either barometric or powered relief sized to prevent overpressurization of the building. Where the cooling *efficiency* meets or exceeds the *efficiency* requirement in Table 6.3.2, no economizer is required. ~~*Outdoor air* dampers for economizer use shall be provided with blade and jamb seals.~~

...

n. ~~Exhausts with a design capacity of over 300 cfm on *systems* that do not operate continuously shall be equipped with gravity or motorized dampers that will automatically shut when the *systems* are not in use~~ Outdoor air intake and exhaust systems shall meet the requirements of Section 6.4.3.4.

...

6.4.3.4.~~3~~2 Shutoff Damper Controls. All *outdoor air* intake and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use. Ventilation *outdoor air* and exhaust/relief dampers shall be capable of automatically shutting off during preoccupancy building warm-up, cool down, and *setback,* except when *ventilation* reduces energy costs or when ventilation must be supplied to meet code requirements.

Exceptions:

a. Backdraft gravity (nonmotorized) dampers are acceptable for exhaust and relief dampers in buildings less than three stories in height and for ventilation air intakes and exhaust and relief dampers in buildings of any height located in climate zones 1, 2, and 3. Backdraft dampers for ventilation air intakes must be protected from direct exposure to wind.

6.4.3.4.3 Dampers Leakage. Where *outdoor air* supply and exhaust/relief dampers are required by Section 6.4.3.4, they shall have a maximum leakage rate when tested in accordance with AMCA Standard 500 as indicated in Table 6.4.3.4.~~4~~3.

~~TABLE 6.4.3.4.3 Maximum Damper Leakage~~

~~Climate Zones~~	~~Maximum Damper Leakage at 250 Pa (L/s per m² of damper area)~~	
	~~Motorized~~	~~Nonmotorized (where permitted)~~[a]
~~1, 2, 6, 7, 8~~	~~20~~	~~100~~
~~3,4, 5~~	~~50~~	~~10~~[a]

[a] Dampers smaller than 0.6 m in either dimension may have leakage of 200 L/s per m^2

TABLE 6.4.3.4.3 Maximum Damper Leakage
(L/s per m^2) at 250 Pa w.g.

	Ventilation Air Intake		Exhaust/Relief	
Climate Zone	non-motorized[1]	motorized	non-motorized[1]	motorized
1,2	-	-	-	-
any height	100	10	100	10
3	-	-	-	-
any height	100	50	100	50
4,5b,5c	-	-	-	-
less than 3 stories	not allowed	50	100	50
3 or more stories	not allowed	50	not allowed	50
5a,6,7,8	-	-	-	-
less than 3 stories	not allowed	10	100	10
3 or more stories	not allowed	10	not allowed	10

[1] Dampers smaller than 0.6 m in either dimension may have leakage of 200 L/s per m^2.

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FOREWORD

This addendum fixes a mistake in the way 8” pipe was analyzed. RS Means data for threaded pipe was used for 8” when welded pipe data should have been used.

It also includes a minor editorial change since it is not possible to operate more than 8760 hrs/yr.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum cc to 90.1-2007

Modify the Standard as follows (I-P Units)

TABLE 6.5.4.5 Piping System Design Maximum Flow Rate in GPM (IP)

Operating hours/yr	≤2000 hours/yr		>2000 and ≤4400 hours/year		>4400 ~~and ≤8760~~ hours/year	
Nominal Pipe Size (in.)	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed
2 1/2	120	180	85	130	68	110
3	180	270	140	210	110	170
4	350	530	260	400	210	320
5	410	620	310	470	250	370
6	740	1100	570	860	440	680
8	~~840~~ 1200	~~1300~~ 1800	~~650~~ 900	~~970~~ 1400	~~510~~ 700	~~770~~ 1100
10	1800	2700	1300	2000	1000	1600
12	2500	3800	1900	2900	1500	2300
Maximum Velocity for Pipes Over 12” Size	8.5 fps	13.0 fps	6.5 fps	9.5 fps	5.0 fps	7.5 fps

Modify the Standard as follows (SI Units)

TABLE 6.5.4.5 Piping System Design Maximum Flow Rate in liters/second (SI)

Operating hours/yr	≤2000 hours/yr		>2000 and ≤4400 hours/year		>4400 ~~and ≤8760~~ hours/year	
DN Pipe Size (mm)	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed
75	8	11	5	8	4	7
90	11	17	9	13	7	11
110	22	33	16	25	13	20
140	26	39	20	30	16	23
160	47	69	36	54	28	43
225	~~53~~ 76	~~82~~ 114	~~41~~ 57	~~61~~ 88	~~32~~ 44	~~49~~ 69
280	114	170	82	126	63	101
315	158	240	120	183	95	145
Maximum Velocity for Pipes Over 315mm Size	2.6 m/s	4.0 m/s	2.0 m/s	2.9 m/s	1.5 m/s	2.3 m/s

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the standards and guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive technical committee structure, continue to generate up-to-date standards and guidelines where appropriate and adopt, recommend, and promote those new and revised standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating standards and guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.