ANSI/ASHRAE/IESNA Addenda d, o, x, aa, ab, ae, at, au, and ba to
ANSI/ASHRAE/IESNA Standard 90.1-2007

ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

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Addendum d to 90.1-2007

Revise the Standard as follows (I-P and SI Units):

Add the following definition to 3.2 Definitions.

daylit area: the floor area substantially illuminated by daylight.

Add the following to Section 3.3, "Abbreviations and Acronyms."

WF well factor

Add the following exception to Section 5.5.4.4.2.

5.5.4.4.2 SHGC of Skylights. *Skylights* shall have an SHGC not greater than that specified for "all" orientations in Tables 5.5-1 through 5.5-8 for the appropriate total *skylight area*.

Exception: *Skylights* are exempt from SHGC requirements provided they:

a. Have a glazing material or diffuser with a measured haze value greater than 90% when tested according to ASTM D1003.
b. Have a *Skylight* VT greater than 0.40, and;
c. Have all general lighting in the *daylit area* under the *skylight* controlled by multilevel photocontrols in accordance with Section 9.4.1.4.

Add new section 5.7.3.

5.7.3 Visible Light Transmittance. Test results required in 5.8.2.6 for *skylight* glazing or diffusers shall be included with construction documents submitted with each application for a permit.

Revise 5.8.2.1, 5.8.2.2, and the Exception to 5.8.2.2 as follows:

5.8.2.1 Rating of Fenestration Products. The *U-factor, Solar Heat Gain Coefficient (SHGC),* Visible Light Transmittance (VT), and air leakage rate for all manufactured *fenestration* products shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council.

5.8.2.2 Labeling of *Fenestration* Products. All manufactured *fenestration* products shall have a permanent nameplate, installed by the manufacturer, listing the *U-factor, Solar Heat Gain Coefficient (SHGC),* ~~and~~ air leakage rate, and where required by the Exception to 5.5.4.4.2, Visible Light Transmittance (VT).

Add the following exception to 5.8.2.6.

5.8.2.6 Visible Light Transmittance. Visible light transmittance shall be determined in accordance with NFRC 200. Visible light transmittance shall be verified and certified by the *manufacturer.*

Exception: For *skylights* whose transmittances are not within the scope of NFRC 200, their transmittance shall be the solar photometric transmittance of the skylight glazing material(s) determined in accordance with ASTM E972.

Add the following new sections 9.4.1.3 and 9.4.1.4, and renumber sections 9.4.1.4 and 9.4.1.3.

9.4.1.3 *Daylit area* under *skylights*. The *daylit area* under each *skylight* shall be

a. the outline of the opening beneath the skylight, plus 70% of the ceiling height in each horizontal direction when there are no *permanently installed* partitions and racks with heights greater than 5 feet (1.5 m) within a horizontal distance of 70% of the ceiling height to the edge of the skylight (See Figures 9.1 and 9.2) or
b. the outline of the opening beneath the *skylight*, plus 40% of the ceiling height in the horizontal directions perpendicular to the racks or partitions, plus 70% of the ceiling height (See Figure 9-1) in directions parallel to the racks or partitions and
c. identified on the building plans.

9.4.1.4 Automatic Daylighting Controls. When the combined *daylit area under skylights* for all *skylight*s in an *enclosed space* exceeds 5000 ft^2 (500 m^2), the lamps for

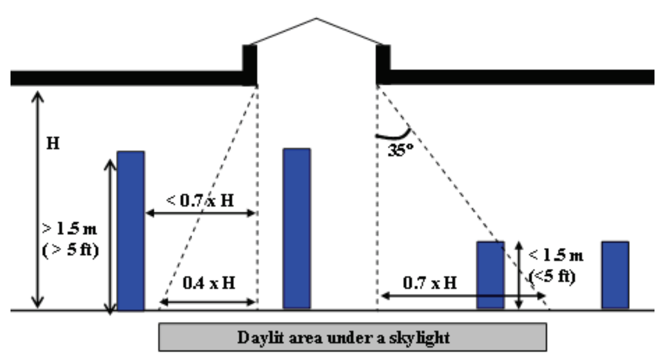

Figure 9.1 Elevation of *daylit area* under *skylights.*

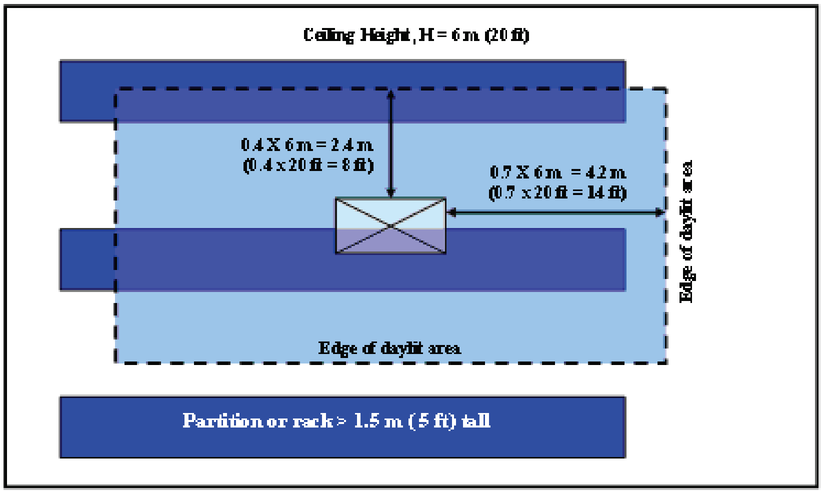

Figure 9.2 Plan view of *daylit area* under *skylights*—6 m high ceiling and partitions greater than 5 feet (1.5m) tall.

general lighting in the *daylit area under skylights* shall be separately controlled by at least one multilevel photocontrol (including continuous dimming devices) having the following characteristics:

a. the light sensor for the photocontrol shall be remote from where calibration adjustments are made,

b. the calibration adjustments shall be readily accessible, and

c. the multilevel photocontrol shall reduce electric lighting in response to available daylight with at least one control step that is between 50% and 70% of design lighting power and another control step that is no greater than 35% of design power.

Exceptions:

a. *Daylighted areas* under *skylights* where it is documented that existing adjacent structures or natural objects block direct beam sunlight for more than 1500 daytime hours per year between 8 am and 4 pm.

b. *Daylighted areas* where the effective aperture (EA) of glazing is less than 0.006 (0.6%).

Formula for Effective Aperture (EA):

$$Effective\ Aperature = \frac{0.85 \times Skylight\ Area \times Skylight\ VLT \times WF}{Daylight\ area\ under\ skylights}$$

where

Skylight Area = total *fenestration area* of *skylights*

Skylight VT = area weighted average visible light transmittance of *skylights* as determined in accordance with 5.8.2.

WF = area weighted average well factor, where well factor is 0.9 if light well depth is less than 0.6 m, or 0.7 if light well depth is 0.6 m or greater. Light well depth is measured vertically from the underside of the lowest point on the skylight glazing to the ceiling plane under the skylight.

c. *Buildings* in climate zone 8 with daylight areas totaling less than 10,000 ft^2 (929 m^2) in an *enclosed space*

d. If all general lighting in the *enclosed space* is controlled by *occupant sensor(s)* that reduces lighting power at least by 50% and the *SHGC* of the *skylights* complies with Section 5.5.4.4.2 without the use of exceptions to Section 5.5.4.4.2

9.4.1.~~4~~5 Additional Control

a. Display/Accent Lighting—display or accent lighting shall have a separate control device...

The remainder of this section does not change.

9.4.1.~~3~~6 Exterior Lighting Control. Lighting for all exterior applications not exempted in 9.1 shall have automatic controls capable of turning off exterior lighting when sufficient...

The remainder of this section does not change.

9.7 Submittals ~~(Not Used)~~

9.7.1 System Commissioning

9.7.1.1 Commissioning Automatic Daylighting Controls. Automatic daylighting control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition to *manufacturer*'s specifications. System performance shall be demonstrated to perform as specified by the design plans and specifications.

Add the following to Section 12, "Normative References"

Reference	Title
ASTM D1003-00	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics
ASTM E972-96 (2002)	Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight

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FOREWORD

Transformers are an integral part of the electric distribution system. They are used to lower the voltage of electricity from utility primary circuits to customer secondary circuits. For many commercial buildings, the electricity from the local electric distribution company is provided at 277 Volts (single phase) and 480 Volts (3 phase). However, most, if not all, commercial facilities have a need for electricity to be supplied at 120 Volts (single phase) or 208 Volts (3 phase) to operate certain equipment, such as computers, printers, copiers, kitchen equipment, etc. Low voltage dry-type transformers, which are purchased by the building owner, are used for this purpose.

According to NEMA and DOE statistics, commercial facilities currently use about 11,000,000 low voltage dry-type transformers in their facilities. Annual domestic shipments are 314,000 units per year. There are other types of transformers, such as medium voltage dry-type and liquid-filled, but the medium-voltage units are far less commonly used (about 3,500 shipped per year) and the liquid-filled are predominantly used by electric distribution companies on the "utility side" of the electric meter. For the medium-voltage dry-type and liquid-filled units, the US Department of Energy (DOE) will be deciding on national energy efficiency standards by the fall of 2007.

Under the Energy Policy Act of 2005, new national minimum efficiency standards went into effect for low voltage dry-type transformers manufactured on or after January 1, 2007. The law refers to Table 4-2 of the National Electrical Manufacturers Association (NEMA) publication NEMA TP-1 Guide for Determining Energy Efficiency for Distribution Transformers (2002).

These standards will result in energy savings for commercial buildings. According to an analysis performed by DOE in 2004 and summarized in the July 29, 2004 edition of the Federal Register (Volume 69, No. 145, pages 45376-45417), the standards shown in the proposed Table 8.1, the Department estimated that national efficiency standards for low voltage dry-type transformers would save 4.74 quads of primary energy over 28 years (2007 to 2035). In terms of cumulative electric site energy savings, that is roughly equivalent to 596 Billion kWh over 28 years, or 21.3 Billion kWh per year. The value is lower in the first 10 years (under 15 Billion kWh per year) and higher in the later years (over 27 Billion kWh per year) as more older units are replaced as the years progress.

These savings are based on NEMA test conditions of 35% of nameplate loads. It should be noted that studies have shown that many dry type transformers have typical loads in the 20-30% range, or lower. The lower the % load, the lower the energy savings from higher efficiency transformers (in many cases). To account for current sales of high efficiency dry-type transformers (there are some state mandates in effect) and to account for actual loading patterns, it is safe to assume an annual average savings of 10 Billion kWh.

According to the EEI Statistical Yearbook, in 2004, the commercial sector of the US economy consumed 1,230,425 GigaWatt-hours. This is equal to 1,230,425,000 MegaWatt-hours, or 1,230,425,000,000 kWh (1.23 Trillion kWh, or 1,230 Million kWh). With savings of 10 Billion kWh per year, the national dry-type low voltage transformer energy efficiency standard will save 10/1230 or 0.8% of the electricity used at commercial facilities.

In terms of economics, in 2004, DOE calculated that the mean payback for low voltage dry-type transformers would range, based on the size of the transformer analyzed, from 0.6 to 1.7 years, with mean life cycle cost savings ranging from $1,777 to $6,761 over a 28 year estimated lifetime. It should be noted that the prices of transformers have increased quite dramatically over the past three years (nearly doubling, in some cases), but the mean paybacks should still be less than 4-5 years for most end-use customers.

Adding this information to the next version of ASHRAE 90.1 will help designers, end-use customers, and code officials with transformer specifications and verifications. These standards have been vetted and analyzed and agreed to by transformer manufacturers.

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Addendum o to 90.1-2007

Revise addendum o as follows (IP and SI units):

8.1 General. ~~This section applies to all building power distribution systems~~.

8.1.1 Scope. This section applies to all building power distribution *systems* and only to equipment described below.

8.1.1.1 New Buildings. Equipment installed in new buildings shall comply with the requirements of this section.

8.1.1.2 Addition to Existing Buildings. Equipment installed in *additions* to *existing buildings* shall comply with the requirements of this section.

8.1.1.3 Alterations to Existing Buildings

8.1.1.3.1 Alterations to building service equipment or systems shall comply with the requirements of this section applicable to those specific portions of the building and its systems that are being altered.

8.1.1.3.2 Any new equipment subject to the requirements of this section that is installed in conjunction with the *alterations*, as a direct replacement of existing equipment shall comply with the specific requirements applicable to that equipment.

TABLE 8.1 Minimum Nominal Efficiency Levels for NEMA Class I Low-Voltage Dry-Type Distribution *Transformers*[a]

Single Phase *Transformers*		Three Phase *Transformers*	
kVA[b]	**Efficiency,%[c]**	**kVA[b]**	**Efficiency,%[c]**
15	97.7	15	97.0
25	98.0	30	97.5
37.5	98.2	45	97.7
50	98.3	75	98.0
75	98.5	112.5	98.2
100	98.6	150	98.3
167	98.7	225	98.5
250	98.8	300	98.6
333	98.9	500	98.7
		750	98.8
		1000	98.9

a. A low voltage distribution *transformer* is a *transformer* that is air-cooled, does not use oil as a coolant, has an input voltage <= 600 Volts, and is rated for operation at a frequency of 60 Hertz.
b. kiloVolt-Amp rating.
c. Nominal efficiencies shall be established in accordance with the NEMA TP-1 2002 test procedure for low voltage dry-type *transformers*. Class I Low Voltage Dry-Type is a National Electrical Manufacturers Association (NEMA) design class designation.

Exception to 8.1.1.3: Compliance shall not be required for the ~~same-site~~ relocation or reuse of existing equipment at the same site.

8.4.2 Low Voltage Dry-Type Distribution *Transformers*. Low voltage dry-type *transformers* shall comply with the provisions of the Energy Policy Act of 2005 where applicable, as shown in Table 8.1. *Transformers* that are not included in the scope of the Energy Policy Act of 2005 have no performance requirements in this section, and are listed for ease of reference as exceptions.

Exceptions:

Transformers that meet the Energy Policy Act of 2005 exclusions based on NEMA TP-1 definition:

a. special purpose applications

b. not likely to be used in general purpose applications

c. *transformers* with multiple voltage taps where the highest tap is at least 20% more than the lowest tap.

Products meeting these criteria and exempted from 8.4.2 include the following: drive *transformer*, rectifier *transformer*, auto-*transformer*, uninterruptible power system *transformer*, impedance *transformer*, regulating *transformer*, sealed and nonventilating *transformer*, machine tool *transformer*, welding *transformer*, grounding *transformer*, or testing *transformer*.

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FOREWORD

This revision to the energy standard updates the requirements for automatic lighting shutoff, adds specific occupancy sensor applications, and provides additional clarification.

The revision extends the requirement for automatic lighting shutoff to all buildings regardless of size (with exceptions). The previous requirement did not apply to smaller buildings because of cost and application concerns related to compliance options. Recent changes in equipment costs eliminates these concerns. A survey of availability of low cost programmable time-of-day control systems suitable for small buildings shows at least 5 different manufacturer's products for these applications (Douglas Wex Litepak, Lithonia SwitchPak, PCI, WattStopper, Blue Box). These are typically 4 – 8 relay products with costs from $700 for 4 relays ($0.70/ft for 1000ft2) to $1000 for 8 relays ($0.33/ft for 3000ft2).

The requirement for occupancy sensor applications in additional specific spaces is also now shown to be cost effective with reduced equipment costs and test data availability. A worst case analysis of the occupancy sensor compliance method shows that the use of sensors in small offices has a conservative simple payback period of 3.5 years. Small offices provide a worst case analysis because of the low level of lighting to be controlled by the sensor (low energy savings) and based on test data, a low rate of unoccupied periods. Other applications are expected to provide higher savings at similar costs and therefore lower simple payback periods.

Small Office—Cost Effectiveness of Occupancy Sensor Control Requirement in Place of Whole Building Auto Shutoff Control, Worst-Case Analysis

Space Assumptions:	Space type: Small Office Area (sq. ft): 100 Fixture Count: 2 Proposed Lighting Load (kW): 0.116
Economic Assumptions:	Initial Cost of Electricity Peak/Nonpeak ($/kWh): $0,0939 $0.0939 Cost of Money: 7.00% Federal Tax Rate: 35.00% Depreciation Method: 15 Year Straight Life Fuel escalation (elec): 3.70%
Energy Savings	Reduction in Annual Energy Costs: $8.36 Reduction in Lighting Energy Use (%): 20.0%
Project Investment:	Reduction in Lighting Energy Use (%): 20.0% Total Occupancy Sensor Net Cost: $50.00 Net Project Investment: $30.00
Economic Analysis:	Simple Payback (years): 3.54 ROI: 28.0%
Revised ROI 4.1 with inflation	

Potential Energy Savings from Occupancy Sensors[3] (Estimated Time Unoccupied)

Type of Space	U.S. EPA Prediction	EPRI Prediction
Private Offices	13%–50%	25%
Classrooms	40%–48%	—
Conference Rooms	22%–65%	35%
Restrooms	30%–90%	40%
Corridors	30%–80%	—
Storage Areas	45%–80%	—
Hotel Meeting Rooms	—	65%

3. Energy Advisor Lighting: Occupancy sensors, Florida Power and Light, 2003, http://www.fpl.com/business/savings/energy_advisor/PA_10.html

Recommended Values for the Three Types of Spaces (Mean Values)

	Private ("Owned")	Shared
Sporadically Use:	25	40
Scheduled Use:		30

DATA SOURCES

Advance Lighting Guidelines, California Energy Commission 1993

Advance Lighting Guidelines, California Energy Commission 2001

E Source Tech Update TU-93-8 Occupancy Sensors: Promises and Pitfalls 1999

EPRI "Occupancy Sensors: Positive On/Off lighting control" 1992 PRT00374

Floyd, David B.; Parker, Denny S.; Sherwin, John R.; "Measured Field Performance and Energy Savings of Occupancy Sensors: Three Cases Studies" FL Energy Ctr online publication

Jennings et al" Comparison of Control Options in an advanced Ltg Controls Testbed" Proceedings IES 1999 (SF Federal Bldg)

Richman et al "Field Analysis of Occupancy Sensor Operations: Parameters Affecting Lighting Energy Savings" JIES96

Energy User News Ambion building article, "Occupancy Sensor Retrofit to Earn 1-yr Payback" Sept. 97

Nilsson, Erik Adelaide Lunch room "Energy-Efficient Ltg in Commercial Bldgs" CADDET 201517 (1985 case study)

Bohrer, James "Case Study on Occupant Sensors as an Office Lighting Control Strategy" Seattle City Light "92 RPT00315

Johnson, Karl F. "Keys to Successful Lighting Control Applications" New York, Illuminating Engineering Society of North America. 8-5-1996. Ref Type: Conference Proceedings 1996 pp. 800-811

Pigg, Scott; Ellers, Mark; Reed, John, "Behavioral Aspects of Lighting and Occupancy Sensors in Private Offices: A Case Study of a University Office Building" ACEEE 1996

Maniccia, D., Rutledge, B., Rea, M.S., and Morrow, W. "Occupancy use of manual lighting controls in private offices. Journal of the Illuminating Engineering Society 28, no. 2 (1999); 42-56,

Jennings, Judith; Colak, Nesrin; Rubinstein, Francis, "Occupancy and Time- based Lighting Controls in Open Offices" Journal IES, Summer 2002

Kaiser/EPRI92 (See reference #4)

Chevron/EPRI92 (See reference #4)

VonNeida, Bill; Maniccia, Dorene; Tweed, Allan; "An Analysis of the Energy and Cost Savings of Occupancy Sensors for Commercial Lighting Systems" 100764

Maniccia, D. "NLPIP Specifier reports; Occupancy Sensors". 20. 1992. Troy, NY, Rensselaer Polytechnic Institute. Specifier Reports.

Figuelro, M.G., Rea, M.S., Rea, A. C., and Stevens, R.G. "Daylight and Productivity – A field study" 2002. Washington DC, American Council for an Energy-Efficient Economy, 2002

Rea, M.S. and Jaekel, R.R. "Monitoring occupancy and light operation." Lighting Research & Technology 19. No. 2 (1987); 45-49.

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Addendum x to 90.1-2007

Modify the Sections 9.1.2, 9.4.1.1 and 9.4.1.2 as follows (SI and IP units).

9.1.2 Lighting Alterations. The replacement of lighting *systems* in any building space shall comply with the *LPD* requirements of Section 9 applicable to that space. New lighting *systems* shall comply with the applicable *LPD* requirements of Section 9. Any new *control devices* as a direct replacement of existing *control devices* shall comply with the specific requirements of Section 9.4.1.2~~(b)~~.

9.4.1.1 Automatic Lighting Shutoff. Interior lighting in *buildings* ~~larger than 5000 ft^2~~ shall be controlled with an *automatic control device* to shut off *building* lighting in all spaces. This *automatic control device* shall function on either

a. a scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times—an independent program schedule shall be provided for areas of no more than 25,000 ft^2 but not more than one floor—or

b. an *occupant sensor* that shall turn lighting off within 30 minutes of an occupant leaving a space—or

c. a signal from another control or alarm system that indicates the area is unoccupied.

Exceptions: The following shall not require an *automatic control device:*

a. Lighting ~~intended~~ required for 24-hour operation

b. Lighting in spaces where patient care is rendered.

c. Spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).

9.4.1.2 Space Control. Each space enclosed by ceiling-height partitions shall have at least one *control device* to independently *control* the *general lighting* within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting.

a. An *occupant sensor* or a timer switch ~~control device~~ shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space~~, except spaces with multi-scene control,~~ in:

1. Classrooms and lecture halls~~(not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms)~~,
2. conference, ~~/~~meeting, and training rooms,
3. employee lunch and break rooms~~.~~,

4. storage and supply rooms between 50 ft^2 and 1000 ft^2,
5. rooms used for document copying and printing,
6. office spaces up to 250 ft^2,
7. restrooms
8. dressing, locker, and fitting rooms.

Exceptions:

a. Spaces with *multiscene control* systems
b. Shop and laboratory classrooms
c. Spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s)
d. Lighting required for 24-hour operation

b. For all other spaces, each *control device* shall be activated either manually by an occupant or automatically by sensing an occupant. Each *control device* shall *control* a maximum of 2500 ft^2 area for a space 10,000 ft^2 or less and a maximum of 10,000 ft^2 area for a space greater than 10,000 ft^2. The occupant shall be able to ~~and be capable of~~ overrideing any time-of-day scheduled shutoff *control* for no more than two ~~four~~ hours.

Exception: Remote location shall be permitted for reasons of safety or security when the remote control device has an indicator pilot light as part of or next to the control device and the light is clearly labeled to identify the controlled lighting.

Add the following definition to section 3.2 (IP and SI Units):

Multiscene control: a lighting control device or system that allows for two or more pre-defined lighting settings, in addition to all off, for two or more groups of luminaires to suit multiple activities in the space, and allows the automatic recall of those settings.

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FOREWORD

This addendum adds space exceptions for automatic lighting controls.

Addendum aa to 90.1-2007

Revise Section 9.4 as follows (IP and S-I Units):

9.4 Mandatory Provisions

9.4.1 Lighting Control. Building controls shall meet the provisions of 9.4.1.1, 9.4.1.2, 9.4.1.3, and 9.4.1.4.

Any *automatic control device* required in sections 9.4.1.1, 9.4.1.2, and 9.4.1.4 shall not be set to automatically turn the lighting on, except in the following spaces where automatic-on is allowed:

a. public corridors and stairwells,
b. restrooms,
c. primary building entrance areas and lobbies,
d. areas where manual-on operation would endanger the safety or security of the room or building occupant(s).

9.4.1.1 Automatic Lighting Shutoff. Interior lighting in *buildings* larger than 5000 ft^2 shall be controlled with an *automatic control device* to shut off *building* lighting in all spaces. This *automatic control device* shall function on either

a. a scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times—an independent program schedule shall be provided for areas of no more than 25,000 ft^2 but not more than one floor—or
b. an *occupant sensor* that shall turn lighting off within 30 minutes of an occupant leaving a space or
c. a signal from another control or alarm system that indicates the area is unoccupied.

Exceptions: The following shall not require an *automatic control device:*

a. Lighting intended for 24-hour operation.
b. Lighting in spaces where patient care is rendered.
c. Lighting in spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).

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FOREWORD

This addendum includes, but does not show, changes made in addendum "d" to 90.1-2007.

Addendum ab to 90.1-2007

Add the following definitions to Section 3.2 as follows (I-P and SI Units):

rooftop monitors: *vertical fenestration* integral to the roof

toplighting: lighting building interiors with daylight admitted through fenestration located on the roof such skylights and rooftop monitors.

daylight area:

a. ***under skylights***: the *daylight area under skylights* is the combined daylight area under each *skylight* without double counting overlapping areas. The daylight area under each skylight is bounded by the opening beneath the skylight, plus horizontally in each direction, the smallest of (See Figure 3.1):
   1. 70% of the ceiling height (0.7 × *CH*), or
   2. the distance to any primary sidelighted area, or the *daylight area under rooftop monitors*, or
   3. the distance to the front face of any vertical obstruction where any part of the obstruction is farther away than 70% of the distance between the top of the obstruction and the ceiling (0.7 × (CH – OH))

where *CH*≡ the height of the ceiling at the lowest edge of the skylight, and *OH* ≡ the height to the top of the obstruction.

b. ***under rooftop monitors***: the *daylight area under rooftop monitors* is the combined *daylight area* under each *rooftop monitor* without double counting overlapping areas. The *daylight area* under each rooftop monitor is the product of the width of the vertical glazing above the ceiling level and the smallest of the following horizontal distances inward from the bottom edge of the glazing, (See Figure 3.2):
   1. the monitor sill height, MSH, (the vertical distance from the floor to the bottom edge of the monitor glazing), or
   2. the distance to the edge of any *primary sidelighted area* or
   3. the distance to the front face of any vertical obstruction where any part of the obstruction is farther away than the difference between the height of the obstruction and the monitor sill height (MSH-OH).

Primary sidelighted area: the total *primary sidelighted area* is the combined *primary sidelighted area* without double counting overlapping areas. The floor area for each *primary sidelighted area* is directly adjacent to vertical glazing below the ceiling with an area equal to the product of the *primary sidelighted area* width and the *primary sidelighted area* depth. See Figure 3.3.

The *primary sidelighted area* width is the width of the window plus, on each side, the smallest of:

1. 2 feet (0.6 m) or
2. the distance to any 5 ft(1.5 m) or higher vertical obstruction.

The *Primary sidelighted area* depth is the horizontal distance perpendicular to the glazing which is the smaller of:

1. one window head height (head height is the distance from the floor to the top of the glazing), or
2. the distance to any 5 ft (1.5 m) or higher vertical obstruction.

***skylight effective aperture*:** the overall amount of visible light transmittance of the *roof* via *skylight*s**.** *Skylight effective aperture* is calculated according to the following formula:

$$Skylight\ Effective\ Aperature = \frac{0.85 \times Skylight\ area \times Skylight\ VLT \times WF}{Daylight\ area\ under\ skylights}$$

where

Skylight area	=	total *fenestration area* of *skylight*s
Skylight VT	=	area weighted average visible light transmittance of *skylight*s as determined in accordance with Section 5.8.2.6
WF	=	area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 feet (0.6 m), or 0.7 if light well depth is 2 feet (0.6 m) or greater

Light well depth is measured vertically from the underside of the lowest point on the *skylight* glazing to the ceiling plane under the *skylight*.

sidelighting effective aperture: relationship of daylight transmitted through windows to the *primary sidelighted areas*. The *Sidelighting Effective Aperture* is calculated according to the following formula:

$$Sidelight\ Effective\ Aperature = \frac{\sum Window\ area \times Window\ VLT}{Area\ of\ primary\ sidelighted\ area}$$

where window VT, is the visible light transmittance of windows as determined in accordance with Section 5.8.2.6.

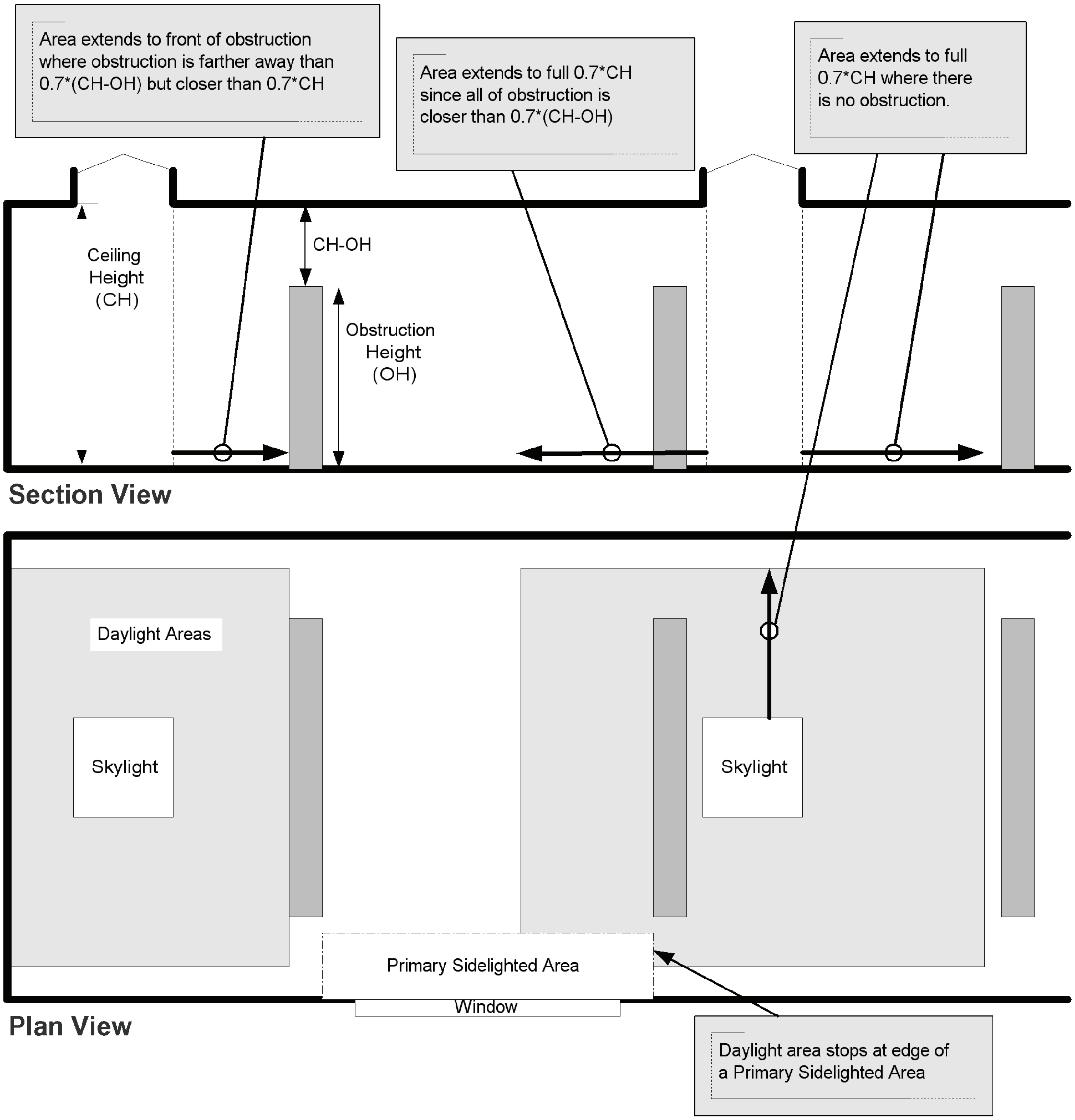


Figure 3.1 Computing the daylight area under skylights.

Revise Section 5 as follows:

5.5.4.4.2 SHGC of Skylights. *Skylights* shall have an *SHGC* not greater than that specified for "all" orientations in Tables 5.5-1 through 5.5-8 for the appropriate total *skylight area*.

Exception: *Skylights* are exempt from SHGC requirements provided they:

a. (a)Have a glazing material or diffuser with a measured haze value greater than 90% when tested according to ASTM D1003.
b. Have a *Skylight* VT greater than 0.40, and;
c. Have all general lighting in the ~~*daylit* area under the *skylight*~~ *daylight area under skylights* controlled by multilevel photocontrols in accordance with Section 9.4.1.4.

Revise Section 9 as follows (I-P and SI Units):

~~**9.4.1.3** Daylit area under skylights. The daylit area under each skylight shall be:~~

~~a. The outline of the opening beneath the skylight, plus 70% of the ceiling height in each horizontal direction when there are no permanently installed partitions and racks with heights greater than 1.5 m within a horizontal distance of 70% of the ceiling height to the edge of the skylight (See Figures 9-1 and 9-2) - or~~

~~b. The outline of the opening beneath the skylight, plus 40% of the ceiling height in the horizontal directions perpendicular to the racks or partitions, plus 70% of the ceiling height (See Figure 9-1)in directions parallel to the racks or partitions.~~

~~c. Identified on the building plans.~~

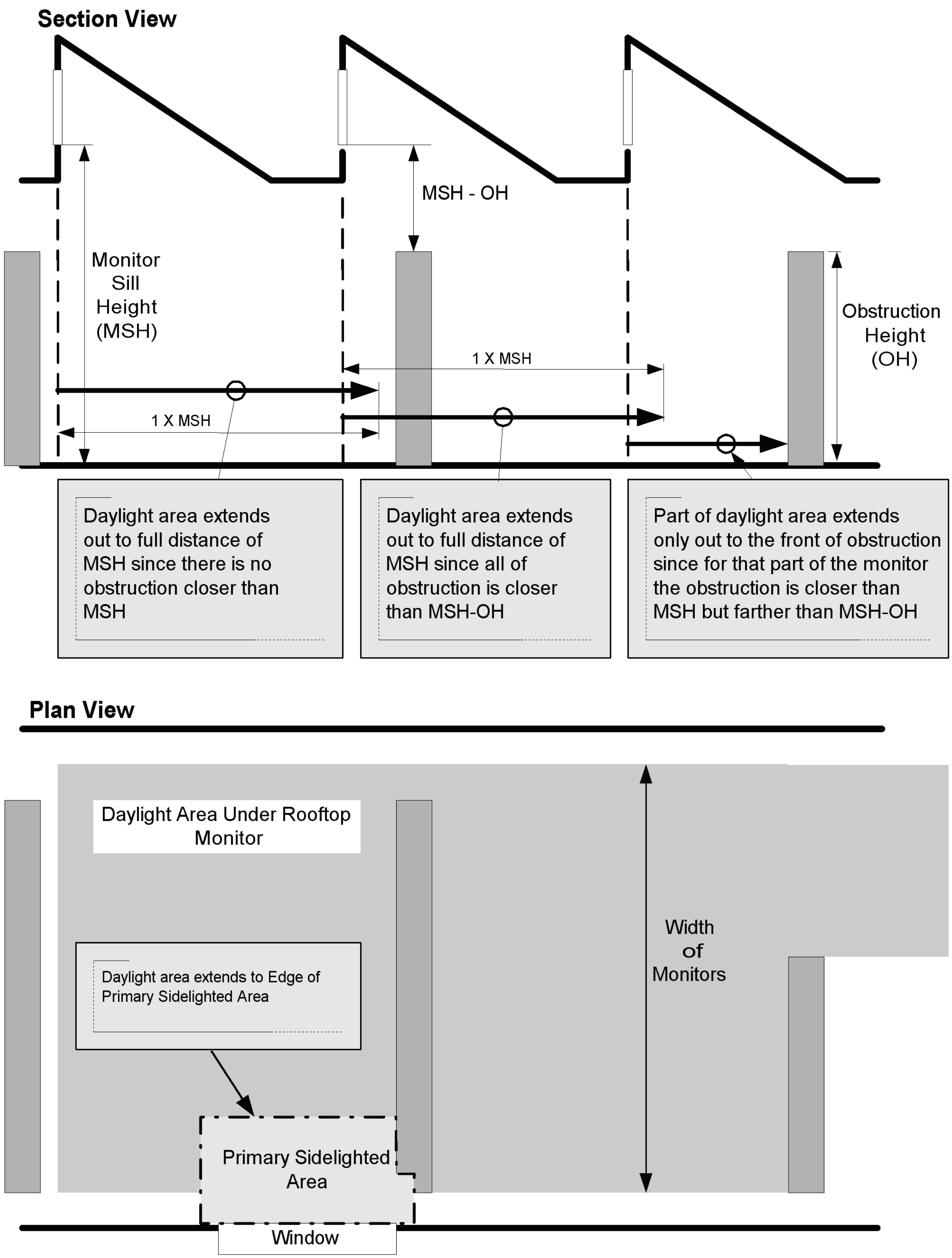


Figure 3.2 Computing the daylight area under rooftop monitors.

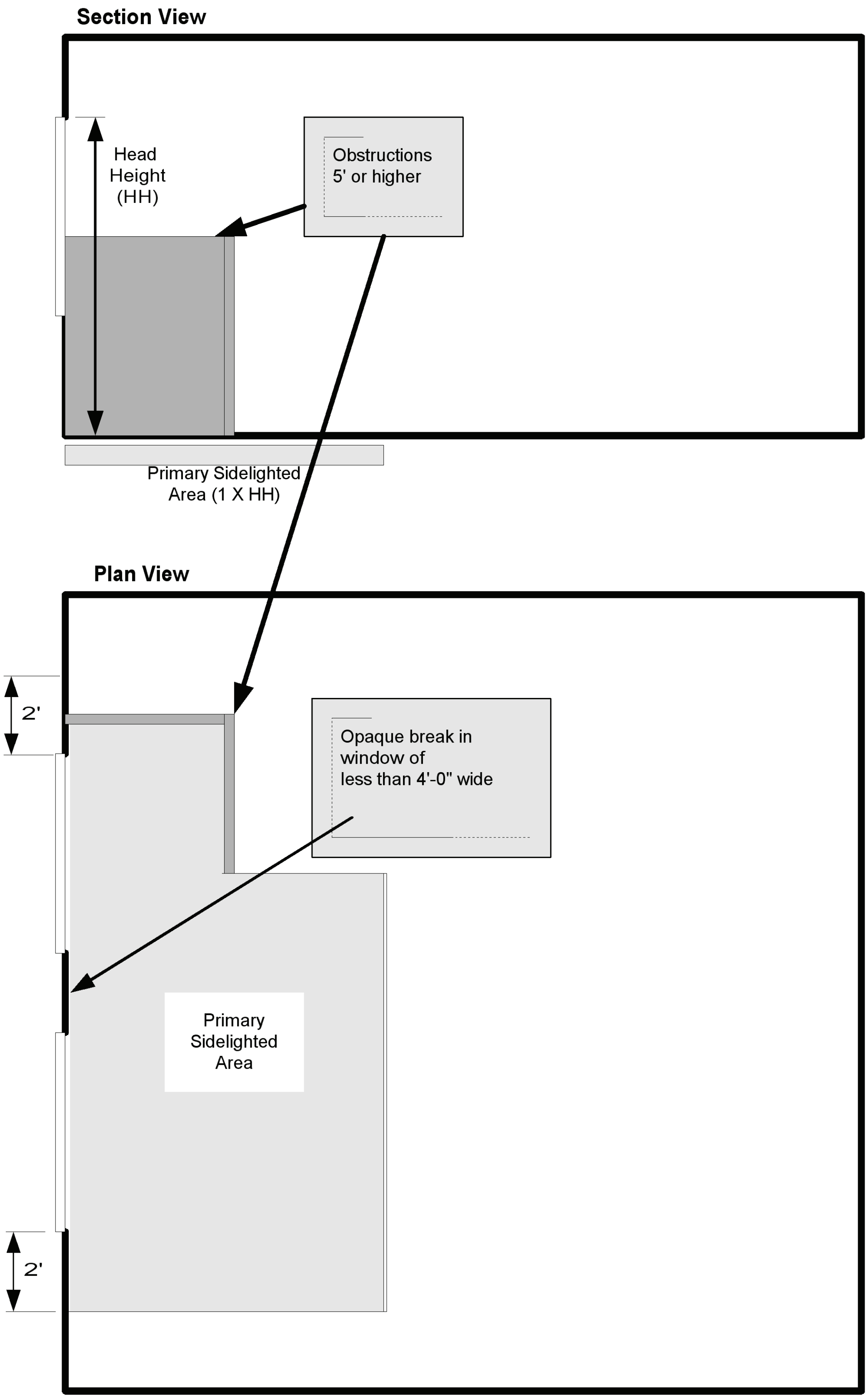
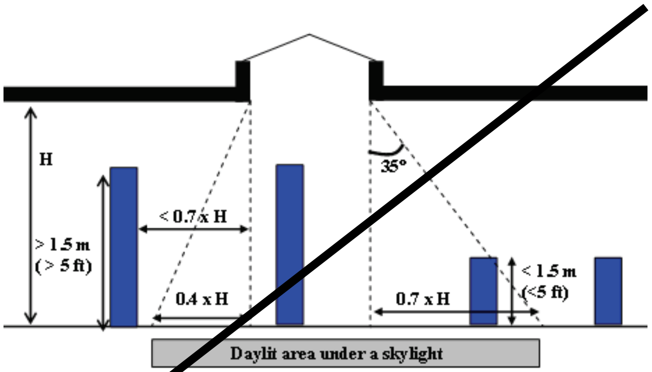
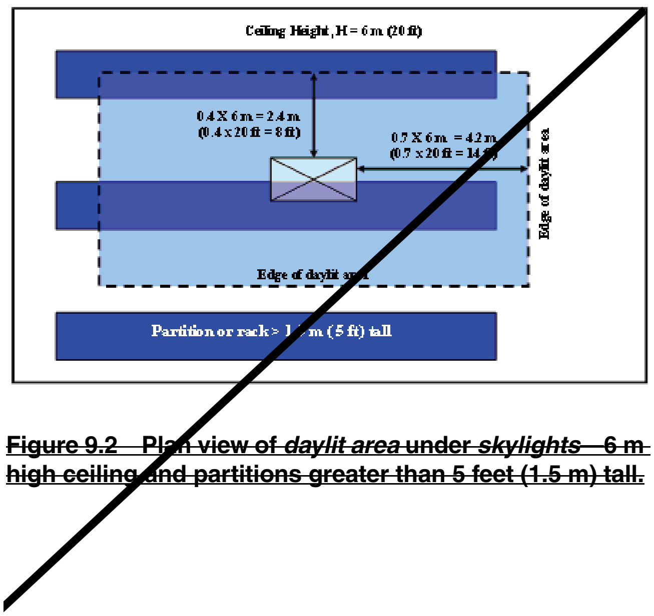


Figure 3.4 Computing the *primary sidelighted area.*



~~**Figure 9.1 Elevation of *daylit area* under *skylights*.**~~



~~**Figure 9.2 Plan view of *daylit area* under *skylights*—6 m high ceiling and partitions greater than 5 feet (1.5 m) tall.**~~

9.4.1.3 Automatic Daylighting Controls for *Primary Sidelighted Areas*. When the combined *primary sidelighted area* in an *enclosed space* exceeds 1000 ft^2 (93 m^2), the lamps for *general lighting* in the *primary sidelighted area* shall be separately controlled by at least one multilevel photocontrol (including continuous dimming devices) having the following characteristics:

a. the light sensor for the photocontrol shall be remote from where calibration adjustments are made;

b. the calibration adjustments shall be readily accessible; and

c. the multilevel photocontrol shall reduce electric lighting in response to available daylight with at least one control step that is between 50% and 70% of design lighting power and another control step that is no greater than 35% (including off) of design power.

Exceptions:

a. *Primary sidelighted areas* where the top of the existing adjacent structures are twice as high above the windows as their distance away from the windows

b. *Primary sidelighted areas* where the *sidelighting effective aperture* is less than 0.1 (10%)

c. retail spaces

9.4.1.4 Automatic Daylighting Controls for *Toplighting*. When the ~~combined~~ total ~~*daylit*~~ *daylight area under skylights* ~~for all skylights~~ plus the total *daylight area under roof top monitors* in an *enclosed space* exceeds ~~5,000 ft^2 (500 m^2)~~ 4,000 ft^2 (371 m^2), the lamps for *general lighting* ~~over~~ in the *daylight area* ~~*daylit area under skylights*~~ shall be separately controlled by at least one multilevel photocontrol (including continuous dimming devices) having the following characteristics:

a. the light sensor for the photocontrol shall be remote from where calibration adjustments are made;

b. the calibration adjustments shall be readily accessible; and

c. the multilevel photocontrol shall reduce electric lighting in response to available daylight with at least one control step that is between 50% and 70% of design lighting power and another control step that is no greater than 35% of design power.

Exceptions:

a. *Daylighted areas* under skylights where it is documented that existing adjacent structures or natural objects block direct beam sunlight for more than 1,500 daytime hours per year between 8 am and 4 pm.

b. *Daylighted areas* where the *skylight effective aperture* ~~of glazing~~ is less than 0.006 (0.6%).

~~Formula for Effective Aperture (EA)~~

~~$$\text{Effective Aperature} = \frac{0.85 \times \text{Skylight Area} \times \text{Skylight VLT} \times WF}{\text{Daylight area under skylights}}$$~~

~~where~~

~~Skylight area = total fenestration area of skylightsSkylight~~

~~VT = area weighted average visible light transmittance of skylights as determined in accordance with 5.8.2.~~

~~WF = area weighted average well factor, where well factor is 0.9 if light well depth is less than 2.0 ft, or 0.7 if light well depth is 2.0 ft, or greater~~

~~Light well depth is measured vertically from the underside of the lowest point on the skylight glazing to the ceiling plane under the skylight.~~

c. Buildings in climate zone 8 with *daylight areas* totaling less than ~~10,000~~ 8000 ft^2 (743 m^2) in an enclosed space.

~~d. If all general lighting in the enclosed space is controlled by occupant sensor(s) that reduces lighting power at least by 50% and the SHGC of the skylights complies with Section 5.5.4.4.2 without the use of exceptions to Section 5.5.4.4.2~~

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FOREWORD

Radiant heating and radiant cooling panels transfer heat to and from occupied spaces primarily via radiation. In some applications (e.g. radiant panels in lay-in ceilings), the back sides of the panels are exposed to unconditioned, indirectly conditioned, or semiheated spaces. In these applications heat transfer from the backs of radiant panels are of less value (and in some conditions negative value).

This proposal recommends adding a requirement for insulating the surfaces of radiant panels that do not face conditioned spaces. Economic analysis was performed. The analysis was not full annual energy comparisons for multiple climate zones. The results were extremely insensitive to the insulation thickness used in the range between 1" and 4", but in all cases adding insulation provided net economic benefits using the approved scalar ratio.

For 1" thickness the savings with the scalar applied were nearly double the first cost for the least attractive application studied (perimeter zone with walls extending to the structure and with a plenum that is not used for return air).

For 1" thickness the savings with the scalar applied were over ten times the first cost for the most attractive application studied (return air plenum with no separate control valves to prevent the use of radiant panels as a form of reheat).

Increasing the insulation thickness provided a small improvement in LCC for many applications, but the LCC did not drop substantially below the LCC for 1" insulation in any case.

Addendum ae to 90.1-2007

Add definitions to Section 3.2 as follows (IP and S-I Units):

3.2 Definitions

sensible cooling panel: a panel designed for sensible cooling of an indoor space through heat transfer to the thermally effective panel surfaces from the occupants and/or indoor space by thermal radiation and natural convection.

sensible heating panel: a panel designed for sensible heating of an indoor space through heat transfer from the thermally effective panel surfaces to the occupants and/or indoor space by thermal radiation and natural convection.

thermally effective panel surface: any exterior surface of a panel, which is intended to transfer heat between the panel and the occupants and/or the indoor space. In this standard, it will be called effective panel surface.

***thermally ineffective panel surface*:** any exterior surface of a panel, which is not intended to transfer heat between the panel and the occupants and/or the indoor space. In this standard, it is called ineffective panel surface.

Modify Section 6 as follows (IP and S-I Units):

6.4.4 HVAC System Construction and Insulation

6.4.4.1 Insulation

6.4.4.1.4 Sensible Heating Panel Insulation. All *thermally ineffective panel surfaces* of *sensible heating panels*, including U-bends and headers, shall be insulated with a minimum of R-3.5 (0.62 m^2/K*W). Adjacent envelope insulation counts toward this requirement.

6.4.4.1.5 Radiant Floor Heating. The bottom surfaces of floor structures incorporating radiant heating shall be insulated with a minimum of R-3.5 (0.62 m^2/K*W). Adjacent envelope insulation counts toward this requirement.

Exception: Requirements for *heated slab-on-grade floors* incorporating radiant heating are in Chapter 5.

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FOREWORD

The changes are mostly meant to clear up inconsistencies and conflicts regarding damper requirements found in several places in Chapter 6. The following discusses the specific changes proposed.

Removal of Section 6.4.3.4.2 Gravity Hoods, Vents, and Ventilators

This section was confusing as there was no definition provided for the three types of equipment which are referenced. The section immediately following this includes "All outdoor air intake and exhaust systems" which should adequately cover these product types.

Modifications to Section 6.4.3.4.3 Shutoff Damper Controls

The language in this section is clarified and a reference to exhaust dampers is specifically added to ensure that exhaust systems are still covered after the removal of Section 6.4.3.4.2.

The example of night purge as an instance where unoccupied ventilation may make sense belongs in the User's Manual instead of the Standard.

The words "gravity damper" are replaced by backdraft damper which is the more common industry wide term.

An exception is added for unconditioned spaces, since damper controls and leakage rate requirements will add cost yet result in no energy savings in these spaces.

An exemption is added for Type 1 kitchen exhaust hoods (grease hoods), since dampers in this application can easily become clogged.

Changes to Table 6.4.3.4.4 Maximum Damper Leakage

Changes to this table eliminate the confusion caused by having "Not Allowed" in the entry for climate zones 1,2,6, 7, and 8. In fact non-motorized dampers are allowed (as stated in the body of the standard) in these climate zones for buildings less than three stories in height. As a further clarification the table will now identify directly the climate zone requirements instead of listing some climate zones in the first row and "All Others" in the second row.

6.5.1.1.4 Dampers *(this section refers to economizer dampers)*

The first change fixes an incorrect reference that had not been updated when section numbers in the previous version of the standard were changed. The existing language requires that economizer return and outdoor air dampers meet the requirements of Section 6.4.3.3.4 Zone Isolation. That reference to the Zone Isolation section is in error. In the 2004 version of the Standard, the same section number was referenced, but then it was the section on dampers pointing to the Maximum Damper Leakage Table. This fixes that error.

This change also adds the term exhaust air to clarify that the reference to outdoor air applies to exhaust dampers as well as the outdoor air supply dampers already mentioned.

Addendum at to 90.1-2007

Revise the Standard as follows (I-P and SI units):

6.4.3.4 Ventilation System Controls

6.4.3.4.1 Stair and Shaft Vents. Stair and elevator shaft vents shall be equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke detection systems.

~~**6.4.3.4.2 Gravity Hoods, Vents, and Ventilators.** All outdoor air supply and exhaust hoods, vents, and ventilators shall be equipped with motorized dampers that will automatically shut when the spaces served are not in use.~~

~~**Exceptions:**~~

~~a. Gravity (nonmotorized) dampers are acceptable in buildings less than three stories in height above grade and for buildings of any height located in climate zones 1, 2, and 3.~~

~~b. Ventilation systems serving *unconditioned spaces*.~~

6.4.3.4.~~3~~2 Shutoff Damper Controls. ~~Both~~ All *outdoor air* ~~supply~~ 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 ~~(e.g., night purge)~~ or when ventilation must be supplied to meet code requirements.

Exceptions:

a. Backdraft ~~G~~gravity (nonmotorized) dampers are acceptable in buildings less than three stories in height and for buildings of any height located in climate zones 1, 2, and 3.

b. Backdraft ~~G~~gravity (nonmotorized) dampers are acceptable in systems with a design *outdoor air* intake or exhaust capacity of 300 cfm (140 L/s) or less.

c. Dampers are not required in ventilation or exhaust systems serving *unconditioned spaces*

d. Dampers are not required in exhaust systems serving Type 1 kitchen exhaust hoods.

6.4.3.4.~~4~~3 Damper~~s~~ Leakage. Where *outdoor air* supply and exhaust/relief ~~air~~ 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 6.4.3.4.4 Maximum Damper Leakage

Climate Zones	Maximum Damper Leakage at 1.0 in. w.g. cfm per ft^2 (250 Pa [L/s per m^2]) of Damper Area	
	Motorized	Nonmotorized (where Permitted)
1, 2, 6, 7, 8	4	~~Not allowed~~ 20
~~All others~~ 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.(200 L/s per m^2)

Renumber subsequent sections (6.4.3.4.5 through 6.4.3.9) as required.

6.5.1.1.4 ~~Both~~ ~~r~~Return, exhaust/relief, and *outdoor air* dampers shall meet the requirements of Section 6.4.3.~~3.~~4 Ventilation System Controls.

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FOREWORD

Table

is an option in the current ASHRAE 90.1-2007 standard that allows for the elimination of the air economizer requirement for air cooled packaged units covered by ARI 340/360 when incremental higher full load efficiencies are used as defined in the table 6.3.2. This table is referred to in the simplified approach in paragraph 6.3.2.c and in the prescriptive path in paragraph 6.5.1 i.

With the new full load and part load efficiencies that will go into effect in 2010 as approved by addendum g to the 2004 standard and addendum s to the 2007 standard, table 6.3.2 needs to also be updated.

Addendum au to 90.1-2007

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

Delete Existing Table 6.3.2

~~TABLE 6.3.2 Eliminate Required Economizer by Increasing Cooling Efficiency~~

~~System Size (kBtu/h)~~	~~Mandatory Minimum EER~~[a]	~~5 to 8~~	~~4~~	~~3~~	~~2~~	~~Test Procedure~~[c]
		~~Climate Zones~~ / ~~Minimum Cooling Efficiency Required (EER)~~[a]				
~~Unitary Systems with Heat Pump Heating~~						
~~≥65 and <135~~	~~10.1~~	~~N/Ab~~	~~12.1~~	~~11.6~~	~~11.1~~	
~~≥135 and <240~~	~~9.3~~	~~N/Ab~~	~~11.3~~	~~10.8~~	~~10.4~~	~~ARI 340/360~~
~~≥240 and <760~~	~~9.0~~	~~N/Ab~~	~~10.9~~	~~10.5~~	~~10.0~~	
~~Other Unitary Systems~~						
~~≥65 and <135~~	~~10.3~~	~~N/Ab~~	~~12.5~~	~~12.0~~	~~11.5~~	
~~≥135 and <240~~	~~9.7~~	~~N/Ab~~	~~11.5~~	~~11.1~~	~~10.6~~	~~ARI 340/360~~
~~≥240 and <760~~	~~9.5~~	~~N/Ab~~	~~11.2~~	~~10.7~~	~~10.3~~	

[a] ~~Each EER shown should be reduced by 0.2 for units with a heating section other than electric resistance heat.~~
[b] ~~Elimination of required economizer is not allowed.~~
[c] ~~Section 12 contains complete specification of the referenced test procedure, including the referenced year version of the test procedure.~~

TABLE 6.3.2 Alternate Compliance Path to Airside Economizers for Unitary Equipment

Unitary Equipment with Electric Resistance or No Heat Covered by Table 6.8.1A

Size Category, Btu/h	Climate Zones					
	1A, 1B, 2A, 3A, 4A	2B, 3B	6A, 6B, 8	4C, 5A, 5C	3C, 4B, 5B	7
≥65,000 and <135,000		11.2 EER 12.7 IEER	11.2 EER 13.8 IEER	11.2 EER 14.9 IEER		Economizer not required
≥135,000 and <240,000	Economizer not required	11.0 EER 12.4 IEER	11.0 EER 13.6 IEER	11.0 EER 14.7 IEER	Economizer required	
≥240,000 and <760,000		11.0 EER 11.2 IEER	11.0 EER 12.2 IEER	11.0 EER 13.2 IEER		Economizer required
≥760,000		9.7 EER 10.9 IEER	9.7 EER 11.9 IEER	9.7 EER 12.8 IEER		

Unitary Equipment with Other Heat Covered by Table 6.8.1A

Size Category, Btu/h	Climate Zones					
	1A, 1B, 2A, 3A, 4A	2B, 3B	6A, 6B, 8	4C, 5A, 5C	3C, 4B, 5B	7
≥65,000 and <135,000		11.0 EER 12.4 IEER	11.0 EER 13.6 IEER	11.0 EER 14.7 IEER		Economizer not required
≥135,000 and <240,000	Economizer not required	10.8 EER 12.2 IEER	10.8 EER 13.3 IEER	10.8 EER 14.4 IEER	Economizer required	
≥240,000 and <760,000		9.8 EER 11.0 IEER	9.8 EER 12.0 IEER	9.8 EER 13.0 IEER		Economizer required
≥760,000		9.5 EER 10.7 IEER	9.5 EER 11.6 IEER	9.5 EER 12.6 IEER		

Unitary and Applied Heat Pumps with Electric Resistance Heat or no Heat Covered by Table 6.8.1B

Size Category, Btu/h	Climate Zones					
	1A, 1B, 2A, 3A, 4A	2B, 3B	6A, 6B, 8	4C, 5A, 5C	3C, 4B, 5B	7
≥65,000 and <135,000		11.0 EER 12.4 IEER	11.0 EER 13.6 IEER	11.0 EER 14.7 IEER		Economizer not required
≥135,000 and <240,000	Economizer not required	10.6 EER 11.9 IEER	10.6 EER 12.9 IEER	10.6 EER 14.0 IEER	Economizer required	Economizer required
≥240,000		9.5 EER 10.7 IEER	9.5 EER 11.6 IEER	9.5 EER 12.6 IEER		

Unitary and Applied Heat Pumps Other Heat Covered by Table 6.8.1B

Size Category, Btu/h	Climate Zones					
	1A, 1B, 2A, 3A, 4A	2B, 3B	6A, 6B, 8	4C, 5A, 5C	3C, 4B, 5B	7
≥65,000 and <135,000		10.8 EER 12.2 IEER	10.8 EER 13.3 IEER	10.8 EER 14.4 IEER		Economizer not required
≥135,000 and <240,000	Economizer not required	10.4 EER 11.7 IEER	10.4 EER 12.7 IEER	10.4 EER 13.8 IEER	Economizer required	Economizer required
≥240,000		9.3 EER 10.4 IEER	9.3 EER 11.4 IEER	9.3 EER 12.3 IEER		

Modify the Standard as follows (SI Units):

Delete Existing Table 6.3.2

~~TABLE 6.3.2 Eliminate Required Economizer by Increasing Cooling Efficiency~~

~~Unitary Systems with Heat Pump Heating~~						
		~~Climate Zones~~				
~~System Size (kW)~~	~~Mandatory Minimum COP$_e$~~[a]	~~5 to 8~~	~~4~~	~~3~~	~~2~~	~~Test Procedure~~[c]
		~~Minimum Cooling Efficiency Required (COP$_e$)~~[a]				
~~≥19 and <40~~	~~2.96~~	~~N/A~~[b]	~~3.55~~	~~3.40~~	~~3.25~~	
~~≥40 and <70~~	~~2.72~~	~~N/A~~[b]	~~3.31~~	~~3.16~~	~~3.05~~	~~ARI 340/360~~
~~≥70 and <223~~	~~2.64~~	~~N/A~~[b]	~~3.19~~	~~3.08~~	~~2.93~~	

~~Other Unitary Systems~~						
		~~Climate Zones~~				
System Size ~~(kW)~~	~~Mandatory Minimum COP$_e$~~[a]	~~5 to 8~~	~~4~~	~~3~~	~~2~~	~~Test Procedure~~[c]
		~~Minimum Cooling Efficiency Required (COP$_e$)~~[a]				
~~≥19 and <40~~	~~3.02~~	~~N/A~~[b]	~~3.66~~	~~3.52~~	~~3.37~~	
~~≥40 and <70~~	~~2.84~~	~~N/A~~[b]	~~3.37~~	~~3.24~~	~~3.11~~	~~ARI 340/360~~
~~≥70 and <223~~	~~2.78~~	~~N/A~~[b]	~~3.28~~	~~3.14~~	~~3.02~~	

[a] ~~Each COP$_e$ shown should be reduced by 0.0586 for units with a heating section other than electric resistance heat.~~
[b] ~~Elimination of required economizer is not allowed.~~
[c] ~~Section 12 contains complete specification of the referenced test procedure, including the referenced year version of the test procedure.~~

TABLE 6.3.2 Alternate Compliance Path to Airside Economizers for Unitary Equipment

Unitary Equipment with Electric Resistance or No Heat Covered by Table 6.8.1A

Size Category (kW)	Climate Zones					
	1A, 1B, 2A, 3A, 4A	2B, 3B	6A, 6B, 8	4C, 5A, 5C	3C, 4B, 5B	7
≥19 and <40	Economizer not required	3.28 COP 3.72 IEER	3.28 COP 4.04 IEER	3.28 COP 4.37 IEER	Economizer required	Economizer not required
≥40 and <70		3.22 COP 3.63 IEER	3.22 COP 3.99 IEER	3.22 COP 4.31 IEER		Economizer required
≥70 and <223		3.22 COP 3.28 IEER	3.22 COP 3.58 IEER	3.22 COP 3.87 IEER		
≥223		2.84 COP 3.19 IEER	2.84 COP 3.49 IEER	2.84 COP 3.75 IEER		

Unitary Equipment with Other Heat Covered by Table 6.8.1A

Size Category (kW)	Climate Zones					
	1A, 1B, 2A, 3A, 4A	2B, 3B	6A, 6B, 8	4C, 5A, 5C	3C, 4B, 5B	7
≥19 and <40	Economizer not required	3.22 COP 3.63 IEER	3.22 COP 3.99 IEER	3.22 COP 4.31 IEER	Economizer required	Economizer not required
≥40 and <70		3.16 COP 3.58 IEER	3.16 COP 3.90 IEER	3.16 COP 4.22 IEER		Economizer required
≥70 and <223		2.87 COP 3.22 IEER	2.87 COP 3.52 IEER	2.87 COP 3.81 IEER		
≥223		2.78 COP 3.14 IEER	2.78 COP 3.40 IEER	2.78 COP 3.69 IEER		

Unitary and Applied Heat Pumps with Electric Resistance Heat or No Heat Covered by Table 6.8.1B

Size Category (kW)	Climate Zones					
	1A, 1B, 2A, 3A, 4A	2B, 3B	6A, 6B, 8	4C, 5A, 5C	3C, 4B, 5B	7
≥19 and <40	Economizer not required	3.22 COP 3.63 IEER	3.22 COP 3.99 IEER	3.22 COP 4.31 IEER	Economizer required	Economizer not required
≥40 and <70		3.11 COP 3.49 IEER	3.11 COP 3.78 IEER	3.11 COP 4.10 IEER		Economizer required
≥70		2.78 COP 3.14 IEER	2.78 COP 3.40 IEER	2.78 COP 3.69 IEER		

Unitary and Applied Heat Pumps Other Heat Covered by Table 6.8.1B

Size Category (kW)	Climate Zones					
	1A, 1B, 2A, 3A, 4A	2B, 3B	6A, 6B, 8	4C, 5A, 5C	3C, 4B, 5B	7
≥19 and <40	Economizer not required	3.17 COP 3.58 IEER	3.17 COP 3.90 IEER	3.17 COP 4.22 IEER	Economizer required	Economizer not required
≥40 and <70		3.05 COP 3.43 IEER	3.05 COP 3.72 IEER	3.05 COP 4.044 IEER		Economizer required
≥70		2.73 COP 3.05 IEER	2.73 COP 3.34 IEER	2.73 COP 3.60 IEER		

(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 pipe insulation levels in the standard assume that the pipes have minimal thermal resistance. This assumption is not true for all piping systems in the market. This addendum allows a system performance option that allows compensating for the insulating value of the piping while maintaining the same net thermal requirements. The differences are not significant enough to modify the insulation thicknesses for most common applications, but become significant for thick non-metallic pipes with small required insulation thicknesses.

Addendum ba to 90.1-2007

Add footnote "e" to Table 6.8.3 as follows (SI and IP):

e. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced insulation thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown in the table.

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.