ADDENDA

**ANSI/ASHRAE/IES Addendum dy to**
**ANSI/ASHRAE/IES Standard 90.1-2013**

# Energy Standard for Buildings Except Low-Rise Residential Buildings

Approved by the ASHRAE Standards Committee on June 25, 2016; by the ASHRAE Technology Council on June 29, 2016; by the IES Board of Directors on June 27, 2016; and by the American National Standards Institute on June 30, 2016.

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## FOREWORD

*This advisory public review identifies SI values that were not correctly or consistently converted from the I-P values. Correcting these conversions will help address the fact that ASHRAE/IES Standard 90.1-2013 contains a number of different SI conversions for the same I-P value. Also, there is at least one existing SI conversion that is off by a factor of 3, a second that is off by a factor of 10, a third that is off by a factor of 100, and a fourth that is off by a factor of 1000. In addition, there are some values in the text and values in figures in the SI version that have I-P units.*

*This document does not address addenda beyond those that are included in the 2015 Supplement to ASHRAE/IES Standard 90.1-2013. Consequently, there may well be other conversions in other addenda that will need to be corrected prior to publication in the 2016 version of ASHRAE/IES Standard 90.1.*

*The project committee believes that the corrections contained in this document are errata. For those specific corrections contained in this document which do not receive any public comment, the project committee recommends that ASHRAE publish these corrections as errata. For any specific corrections contained in this document which do receive public comments, the project committee will review the comments and evaluate whether to recommend a formal public review for those corrections.*

***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 dy to 90.1-2013

*Revise the Standard as follows*

### 3 DEFINITIONS, ABBREVIATIONS, AND ACRONYMS

### 3.2 Definitions

***daylight area:*** …

**Figure 3.2-1 Computing the daylight area under roof monitors**
Plan View: Monitor extends ~~2 feet~~ 2 ft (~~2 feet~~ 0.6 m) beyond…

**Figure 3.2-3 Computing the primary sidelighted area**
Section View: Obstructions ~~5'~~ 5 ft (~~5'~~ 1.5 m) or higher

**Figure 3.2-4 Computing the secondary sidelighted area**
Section View: Obstructions ~~5'~~ 5 ft (~~5'~~ 1.5 m) or higher
Plan View: Obstructions ~~5'~~ 5 ft (~~5'~~ 1.5 m) or higher

### 5 BUILDING ENVELOPE

**5.4.3.2 Fenestration and Doors.** Air leakage for fenestration and doors shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283 as specified below. Air leakage shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council, and shall be labeled and certified by the manufacturer. Air leakage shall not exceed

a. 1.0 cfm/ft$^2$ (~~18.3 m$^3$/h·m$^2$~~ 5.1 L/s·m$^2$) for glazed swinging entrance doors and revolving doors, tested at a pressure of at least 1.57 psf (75 Pa) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283;

b. 0.06 cfm/ft$^2$ (~~1.1 m$^3$/h·m$^2$~~ 0.3 L/s·m$^2$) for curtainwall and storefront glazing, tested at a pressure of at least 1.57 psf (75 Pa) or higher in accordance with NFRC 400 or ASTM E283;

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c. 0.3 cfm/ft$^2$ (~~5.5 m$^3$/h·m$^2$~~1.5 L/s·m$^2$) for unit skylights having condensation weepage openings, tested at a pressure of at least 1.57 psf (75 Pa) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400, or 0.5~~.~~0 cfm/ft$^2$ (~~9.1 m$^3$/h·m$^2$~~2.5 L/s·m$^2$) tested at a pressure of at least 6.24 psf (300 Pa) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440;

d. 1.3 cfm/ft$^2$ (~~23.8 m$^3$/h·m$^2$~~6.6 L/s·m$^2$) for nonswinging doors intended for vehicular access and material transportation, with a minimum opening rate of 32 in./sec (~~0.81~~ 0.8 m/sec), tested at a pressure of at least 1.57 psf (75 Pa) or higher in accordance with ANSI/DASMA 105, NFRC 400, or ASTM E283.

e. 0.4 cfm/ft$^2$ (~~7.3 m$^3$/h·m$^2$~~2.0 L/s·m$^2$) for other nonswinging opaque doors, glazed sectional garage doors, and upward acting nonswinging glazed doors tested at a pressure of at least 1.57 psf (75 Pa) or higher in accordance with ANSI/DASMA 105, NFRC 400, or ASTM E283; and

f. 0.2 cfm/ft$^2$ (~~3.7 m$^3$/h·m$^2$~~1.0 L/s·m$^2$) for all other products tested at a pressure of at least 1.57 psf (75 Pa) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400, or 0.3 cfm/ft$^2$ (~~5.5 m$^3$/h·m$^2$~~1.5 L/s·m$^2$) tested at a pressure of at least 6.24 psf (300 Pa) in accordance with AAMA/ WDMA/CSA 101/I.S/A440.

**Exceptions:**

1. Field-fabricated fenestration and doors
2. Metal coiling doors in semiheated spaces in Climate Zones 1 through 6
3. Products in buildings that comply with a whole building air leakage rate of 0.4 cfm/ft$^2$ (~~7.3 m$^3$/h·m$^2$~~ 2 L/s·m$^2$) under a pressure differential of 0.3 in. $H_2O$ (2 L/s·m$^2$) at 1.57 psf (75 Pa) when tested in accordance with ASTM E 779

**…**

**5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance.** Roofs in Climate Zones 1 through 3 shall have one of the following:

…

c. Increased roof insulation levels found in Table 5.5.3.1.1.

**Exceptions:**

1. Ballasted roofs with a minimum stone ballast of 17 lb/ft$^2$ (~~74~~ 83 kg/m$^2$) or 23 lb/ft$^2$ (~~117~~ 112 kg/m$^2$) pavers

…

**5.5.3.2 Above-Grade Wall Insulation.** All above-grade walls shall comply with the insulation values specified in Tables 5.5-0 through 5.5-8.

**Exception:** Alternatively, for mass walls, where the requirement in Tables 5.5-0 through 5.5-8 is for a maximum assembly U-0.151 (~~U-0.86~~ U-0.857) followed by footnote "b," ASTM C90 concrete block walls, ungrouted or partially grouted at 32 in. (800 mm) or less on center vertically and 48 in. (1200 mm) or less on center horizontally, shall have ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu·in./h·ft$^2$·°F (0.063 W/m·K). Other mass walls with integral insulation shall meet the criteria when their U-factors are equal to or less than those for the appropriate thickness and density in the "Partly Grouted, Cells Insulated" column of Table A3.1-3.

…

## 6 HEATING, VENTILATING, AND AIR CONDITIONING

**6.4.1.1 Minimum Equipment Efficiencies—Listed Equipment—Standard Rating and Operating Conditions…**
All furnaces with input ratings of ≥225,000 Btu/h (≥~~65~~ 66 kW), including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75% of the input rating.

…

**6.4.3.10.1 DDC Applications.**

**Table 6.4.3.10.1**

… fan system bhp of 10 hp (~~7.45~~ 7.5 kW) and larger…[in two places]

… capacity of 300,000 Btu/h (~~87.9~~ 88 kW) and larger…[in four places]

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**6.5.1.1.3 Integrated Economizer Control…**

a. …

b. DX units that control the capacity of the mechanical cooling directly based on occupied space temperature shall have a minimum of two stages of mechanical cooling capacity per the following effective dates:

> 75,000 Btu/h (22 kW) Rated Capacity—Effective 1/1/2014

≥ 65,000 Btu/h (~~18~~ 19 kW) Rated Capacity—Effective 1/1/2016

**…**

**6.5.1.4 Other DX Units.**

**Table 6.5.1.4**

… Rating capacity of ≥ 65,000 Btu/h (~~18~~ 19 kW) and < 240,000 Btu/h (70 kW)…

**…**

**6.5.3 Air System Design and Control.** Each HVAC system having a total fan system motor nameplate hp exceeding 5 hp (~~4~~ 3.7 kW) shall meet the provisions of Sections 6.5.3.1 through 6.5.3.5.

**…**

**6.5.3.1.3 Fan Efficiency…**

**Exceptions:**

1. Single fans with a motor nameplate horsepower of 5 hp (~~3.75~~ 3.7 kW) or less
2. Multiple fans in series or parallel (e.g., fan arrays) that have a combined motor nameplate horsepower of 5 hp (~~4~~ 3.7 kW) or less and are operated as the functional equivalent of a single fan
3. …

**Table 6.5.3.2.1 Effective Dates for Fan Control**

… 5 hp (~~0.75~~ 3.7 kW) …

… 1/4 hp (~~0.2~~ 0.19 kW) …

**…**

**6.5.3.5 Fractional Horsepower (Kilowatt) Fan Motors.** Motors for fans that are 1/12 hp (62.1 W) or greater and less than 1 hp (~~0.746~~ 0.75 kW) shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.

**…**

**6.5.6.2.1** Condenser heat recovery systems shall be installed for heating or preheating of service hot water provided all of the following are true:

a. The facility operates 24 hours a day.

b. The total installed heat rejection capacity of the watercooled systems exceeds 6,000,000 Btu/h (1800 kW) of heat rejection.

c. The design service water heating load exceeds 1,000,000 Btu/h (~~300~~ 293 kW).

**…**

**6.5.11.1 Condensers Serving Refrigeration Systems.** Fan-powered condensers shall conform to the following requirements:

a. …

b. Condenser fan motors that are less than 1 hp (~~75~~ 0.75 kW) shall use electronically commutated motors, permanent split capacitor-type motors, or three-phase motors.

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## 7 SERVICE WATER HEATING

**7.4.2 Equipment Efficiency.** All water heating equipment, hot-water supply boilers used solely for heating potable water, pool heaters, and hot-water storage tanks shall meet the criteria listed in Table 7.8…

**Table 7.8 Performance Requirements for Water-Heating Equipment**

…300,000 Btu/h (~~61.55~~ 88 kW)…

## 10 OTHER EQUIPMENT

**10.4.1 Electric Motors.** Electric motors manufactured alone or as a component of another piece of equipment with a power rating of 1 hp (0.75 kW) or more, and less than or equal to 200 hp (150 kW), shall comply with the requirements of the Energy Independence and Security Act of 2007, as shown in Table 10.8-1 for general purpose electric motors (subtype I) and Table 10.8-2 for general purpose electric motors (subtype II).

General purpose electric motors with a power rating of more than 200 hp (~~149.2~~ 150 kW, but no more than 500 hp (373 kW, shall have a minimum nominal full-load efficiency that is not less than as shown in Table 10.8-3.

## 11 ENERGY COST BUDGET METHOD

**11.5.1 Calculation of Design Energy Cost and Energy Cost Budget:**

**Table 11.5.1 #8 Thermal Blocks—HVAC Zones Not Designed, Proposed Building Design**

Where the HVAC zones and systems have not yet been designed, thermal blocks shall be defined based on similar internal load densities, occupancy, lighting, thermal and space temperature schedules, and in combination with the following:

a. Separate thermal blocks shall be assumed for interior and perimeter spaces. Interior spaces shall be those located more than 15 ft (~~15 ft~~ 4.6 m) from an exterior wall. Perimeter spaces shall be those located closer than 15 ft (~~15 ft~~ 4.6 m) from an exterior wall.

b. Separate thermal blocks shall be assumed for spaces adjacent to glazed exterior walls; a separate zone shall be provided for each orientation, except that orientations that differ by no more than 45 degrees may be considered to be the same orientation. Each zone shall include all floor area that is 15 ft (~~15 ft~~ 4.6 m) or less from a glazed perimeter wall, except that floor area within
15 ft (~~15 ft~~ 4.6 m) of glazed perimeter walls having more than one orientation shall be divided proportionately between zones…

## Normative Appendix G PERFORMANCE RATING METHOD

**G3.1 Building Performance Calculations…**

**Table G3.1 #8. Thermal Blocks – HVAC Zones Not Designed, Proposed Building Performance**

…

a. Separate thermal blocks shall be assumed for interior and perimeter spaces. Interior spaces shall be those located greater than 15 ft (~~5~~ 4.6 m) from an exterior wall. Perimeter spaces shall be those located within 15 ft (~~5~~ 4.6 m) of an exterior wall.

b. Separate thermal blocks shall be assumed for spaces adjacent to glazed exterior walls; a separate zone shall be provided for each orientation, except that orientations that differ by less than 45 degrees may be considered to be the same orientation. Each zone shall include all floor area that is 15 ft (~~5~~ 4.6 m) or less from a glazed perimeter wall, except that floor area within 15 ft (~~5~~ 4.6 m) of glazed perimeter walls having more than one orientation shall be divided proportionately between zones…

**G3.1.1 Baseline HVAC System Type and Description.** HVAC systems in the baseline building design shall comply with the following:

…

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d. For laboratory spaces in a building having a total laboratory exhaust rate greater than 15,000 cfm (7100 L/s), use a single system of type 5 or 7 serving only those spaces. The lab exhaust fan shall be modeled as constant horsepower reflecting constant-volume stack discharge with outdoor air bypass.

…

g. Computer rooms in buildings with a total computer room peak cooling load >3,000,000 Btu/h (~~590~~ 880 kW) or a total computer room peak cooling load >600,000 Btu/h (175 kW) where the baseline HVAC system type is 7 or 8 shall use System 11. All other computer rooms shall use System 3 or 4.

…

**Table G3.1.1-3 Baseline HVAC System Types**

… 120,000 ft$^2$ (~~11.148~~ 11,000 m$^2$) …[in two places]

…

Footnote 3… greater than 15,000 cfm (7100 L/s), use a…

…

**G3.1.2.5 Ventilation**...

**Exceptions:**

1. When modeling demand-control ventilation in the *proposed design* in systems with outdoor air capacity less than or equal to 3000 cfm (1400 L/s) serving areas with an average design capacity of 100 people per 1000 ft$^2$ (93 m$^2$) or less.

…

**G3.1.2.10 Exhaust Air Energy Recovery.** Individual fan systems that have both a design supply air capacity of 5000 cfm (2400 L/s) or greater and have a minimum design outdoor air supply...

**Exceptions:…**

1. Systems serving spaces that are not cooled and that are heated to less than 60°F (16°C).

…

**G3.1.3.5 Hot-Water Pumps.** The *baseline building design* hot-water pump power shall be 19 W/gpm (~~301 kW/1000 L/s~~ 300 W·s/L). The pumping system shall be modeled as primary-only with continuous variable flow. Hot-water systems serving 120,000 ft$^2$ (~~11,160~~ 11,000 m$^2$) or more shall be modeled with variable-speed drives, and systems serving less than 120,000 ft$^2$ (~~11,160~~ 11,000 m$^2$) shall be modeled as riding the pump curve.

**Exception:** The pump power for systems using purchased heat shall be 14 W/gpm (~~222 kW/1000 L/s~~ 220 W·s/L).

**G3.1.3.10 Chilled-Water Pumps (Systems 7, 8, and 11).** The *baseline building design* pump power shall be 22 W/gpm (~~349 kW/1000 L/s~~ 350 W·s/L). Chilled-water systems with a cooling capacity of 300 tons (~~11,148 m$^2$~~ 1055 kW) or more shall be modeled as primary/secondary systems with variable-speed drives on the secondary pumping loop. Chilled-water pumps in systems serving less than 300 tons (~~11,148 m$^2$~~ 1055 kW) cooling capacity shall be modeled as a primary/secondary systems with secondary pump riding the pump curve. For computer room systems using System 11 with an integrated water-side economizer, the *baseline building design* primary chilled-water pump power shall be increased 5 W/gpm (~~80 kW/1000 L/s~~ 80 W·s/L) for flow associated with the water-side economizer.

**Exception:** The pump power for systems using purchased chilled water shall be 16 W/gpm (~~960 kW/1000 L/s~~ 250 W·s/L).

**G3.1.3.11 Heat Rejection (Systems 7, 8, 9, 12, and 13).** The heat rejection device shall be an axial-fan open-circuit cooling tower with variable-speed fan control and shall have an *efficiency* of 38.2 gpm/hp (3.23 L/s·kW) at the conditions specified in Table 6.8.1-7…

The tower shall be controlled to maintain a 70°F (21°C) leaving water temperature where weather permits, floating up to leaving water temperature at design conditions. The baseline building design condenser-water pump power shall be 19 W/gpm (~~310 kW/1000 L/s~~ 300 W·s/L). For computer room systems using System 11 with an integrated water-side economizer, the baseline building design condenser water-pump power shall be increased 5 W/gpm (~~80 kW/1000 L/s~~ 80 W·s/L) for flow associated with the water-side economizer. Each chiller shall be modeled with separate condenser water and chilled-water pumps interlocked to operate with the associated chiller.

**G3.1.3.19 Preheat Coils (Systems 5 through 8).** The baseline system shall be modeled with a preheat coil controlled to a fixed setpoint 20°F (11°C) less than the design room heating temperature setpoint.

## 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.

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