BSR/ASHRAE/IES Addendum cr
to ANSI/ASHRAE/IES Standard 90.1-2022

Public Review Draft

Proposed Addendum cr to Standard 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

First Public Review (April 2025)
(Draft Shows Proposed Changes to Current Standard)

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FOREWORD

In response to a continuous maintenance proposal, the first purpose of this addendum clarifies System Type 11 heating requirements by splitting into two separate Systems. Previously a note directed the user to distinguish between fossil fuel or electric heat. This was a different method than used with the other System Types where a separate system type was defined for each heating fuel type. This addendum splits System 11 into two different types differentiated by the heating fuel type. Subsequent re-numbering of the downstream System Types plus updates to the System Type numbering throughout Appendix G is included.

The second, and related to the same sections, updates to Section G3.2.2.5 and G3.2.2.5.1 language to improve clarity and usability. Table G3.1 #5 is updated to disallow aggregating zones that have different baseline economizer requirements into one thermal block. Section G3.2.1.2 is updated to require using separate *single-zone systems* 3 or 4, depending on the climate zone, for any *HVAC zone* that has economizer requirements that differ from other *HVAC zones* served by *systems 5-8*.

This addendum impacts an optional performance path in the standard designed to provide increased flexibility and therefore was not subjected to cost effectiveness analysis.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum cr to 90.1-2022

Modify the standard as follows (IP and SI Units)

G3.2.1.2 Additional and Adjusted Baseline HVAC System Types. Baseline HVAC *systems* shall be added or adjusted for individual *HVAC zones* based on the following criteria.

d. The baseline *HVAC system* serving *HVAC zones* that include *computer rooms* shall be modeled in accordance with one of the following:
   1. Baseline *System* 11 or 12 shall be used for such *HVAC zones* in *buildings* with a total *computer room* peak cooling load greater than 3,000,000 Btu/h 880 kW.
   2. Baseline *System* 11 or 12 shall be used for such *HVAC zones* in *buildings* where the baseline *HVAC system* type is 7 or 8 and the total *computer room* peak cooling load is greater than 600,000 Btu/h 175 kW.
   3. Baseline *System* 3 or 4 shall be used for all other *HVAC zones* that include *computer rooms* based on climate zone.
   4. Where Baseline *System* 11 or 12 are required to be modeled, *System* 12 shall be modeled for Climate Zones 0 through 3A. *System* 11 shall be modeled for all other climate zones.

a. *Residential associated HVAC zones* shall use *system* type 3 or 4 based on climate zone.

b. If the baseline *HVAC system* type is 5, 6, 7, or 8 use separate *single-zone systems* conforming with the requirements of *system* 3 or *system* 4 for any *HVAC zone* that has economizer requirements that differ from other *HVAC zones* served by the *system*.

G3.2.1.3 For baseline *HVAC systems* 1, 2, 3, 4, 9, 10, 11, 12, 13, and ~~13~~14, each *HVAC zone* or *thermal block* shall be modeled with its own *HVAC system*. For Systems 5, 6, 7, and 8, each *floor* shall be modeled with a separate *HVAC system*. *Floors* with identical *HVAC zones* or *thermal blocks* can be grouped for modeling purposes.

Exception to G3.2.1.3: Baseline *system* 5 or 7 serving laboratory *spaces* in accordance with Section G3.2.1.2(b).

G3.2.2.5 Economizers. ~~*Air economizers* shall not be included in~~ Systems in the *baseline building design* shall comply with the following economizer requirements.

1. ~~baseline~~ Baseline *HVAC Systems* 1, 2, 9, and 10 shall not include an economizer.

2. Baseline *HVAC systems* 11 and 12 that serve *computer rooms* shall include an integrated *fluid economizer* meeting the requirements of Section 6.5.1.2.

3. Integrated *air economizer* control shall be included in baseline *HVAC Systems* 3 through 8, and 11 through ~~, 12, and 13~~14 based on climate as specified in Table G3.2.2.5.

Exceptions to G3.2.2.5(3): ~~Economizers shall not be included for *systems* meeting one or more of the exceptions listed below.~~

~~1.~~ Baseline ~~S~~*systems* that include gas-phase air cleaning to meet the requirements of Standard 62.1, Section 6.1.2. This exception shall only be used ~~only if~~ when the corresponding *system* in the *proposed design* does not ~~match the *building* design.~~ have an economizer.

2. Baseline *systems* ~~W~~where the use of *outdoor air* for cooling will affect supermarket open refrigerated casework *systems*. This exception shall only be used if the corresponding *system* in the *proposed design* does not use an economizer. ~~If the exception is used, an economizer shall not be included in the baseline building design.~~

3. Baseline ~~S~~*systems* 3 or 4 that serve *computer rooms* ~~complying with Section G3.2.2.5.1~~.

~~**G3.2.2.5.1 Computer Room Economizers.** *Systems* that serve *computer rooms* that are *HVAC System* 3 or 4 shall not have an economizer. *Systems* that serve *computer rooms* that are *HVAC System* 11 shall include an integrated *fluid economizer* meeting the requirements of Section 6.5.1.2 in the *baseline building design*.~~

Table G3.1 Modeling Requirements for Calculating Proposed Building Performance and Baseline Building Performance

Proposed Building Performance	Baseline Building Performance
7. Thermal Blocks—HVAC Zones Designed	
Where *HVAC zones* are defined on HVAC design drawings, each *HVAC zone* shall be modeled as a separate *thermal block*. **Exception:** Different *HVAC zones* may be combined to create a single *thermal block* or identical *thermal blocks* to which multipliers are applied, provided that all of the following conditions are met: 1. The *space* use classification is the same throughout the *thermal block,* or all of the zones have peak internal loads that differ by less than 10 Btu/h·ft^2 from the average. 2. All *HVAC zones* in the *thermal block* that are adjacent to glazed *exterior walls* and glazed *semiexterior walls* face the same *orientation* or their *orientations* vary by less than 45 degrees. 3. All of the zones are served by the same *HVAC system* or by the same kind of *HVAC system*. 4. All of the zones have schedules that differ by 40 or less equivalent full-load hours per week. 5. *HVAC zones* subject to exception to G3.2.2.5 item 3 shall not be combined with the zones that are not subject to these exceptions.	Same as *proposed design*.

G3.2.2.8 System Fan Power. *System* fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered *VAV* boxes) shall be calculated using the following formulas:

For *Systems* 1 and 2,

$$P_{fan} = \text{CFM}_s \times 0.3 P_{fan} = \text{Airflow}_s \times 0.64$$

For *Systems* 3 through 8, and 11, 12, 13, and ~~13~~14,

$$P_{fan} = \text{bhp} \times 746 \text{ input } kW \text{ /fan motor } efficiency$$

For *Systems* 9 and 10 (supply fan),

$$P_{fan} = \text{CFM}_s \times 0.3 \text{ Airflow}_s \times 0.64$$

For *Systems* 9 and 10 (non-*mechanical cooling* fan if required by Section G3.2.2.7.2),

$$P_{fan} = \text{CFM}_{nmc} \times 0.054 \text{ Airflow}_{nmc} \times 0.114$$

where

P_{fan}	=	electric power to fan motor, W
bhp input *kW*	=	brake horsepower input *kilowatts* of baseline fan motor from Table G3.2.2.8
fan motor *efficiency*	=	the *efficiency* for the next motor size greater than the bhp input *kW* from Table G3.2.2.8
CFM_s Airflow_s	=	the baseline *system* maximum design supply fan airflow rate, cfm L/s
CFM_{nmc} Airflow_{nmc}	=	the baseline non-*mechanical cooling* fan airflow, cfm L/s

G3.2.3.2 Type and Number of Boilers (Systems 1, 5, 7, 11, and ~~12~~13). The *boiler* plant shall be natural draft, except as noted in Section G3.2.1.4. The *baseline building design boiler* plant shall be modeled as hav- ing a single *boiler* if the *baseline building design* plant serves a *gross conditioned floor area* of 15,000 ft² 1400 m² or less, and as having two equally sized *boilers* for plants serving more than 15,000 ft² 1400 m². *Boilers* shall be staged as required by the load.

G3.2.3.3 Hot-Water Supply Temperature (Systems 1, 5, 7, 11, and ~~12~~13). Hot-water design supply temperature shall be modeled as 180°F 82°C and design return temperature as 130°F 54°C.

G3.2.3.4 Hot-Water Supply Temperature Reset (Systems 1, 5, 7, 11, and ~~12~~13). Hot-water supply temperature shall be *reset* based on outdoor dry-bulb temperature using the following schedule: 180°F82°C at 20°F–7°C and below, 150°F66°C at 50°F10°C and above, and ramped linearly between 180°F82°C and 150°F66°C at temperatures between 20°F–7°C and 50°F10°C.

Exception to G3.2.3.4: *Systems* served by purchased heat.

G3.2.3.5 Hot-Water Pumps (Systems 1, 5, 7, 11, and ~~12~~13). The *baseline building design* hot-water *pump* power shall be 19 W/gpm. The pumping *system* shall be modeled as primary-only with continuous variable flow and a minimum of 25% of the design flow rate. Hot-water *pumps* shall only be enabled when a load exists on the associated hot-water loop. Hot-water *systems* serving 120,000 ft²or more shall be modeled with variable-speed drives, and *systems* serving less than 120,000 ft² shall be modeled as riding the *pump* curve.

Exception to G3.2.3.5: The *pump* power for *systems* using purchased heat shall be 14 W/gpm.

G3.2.3.6 Piping Losses (Systems 1, 5, 7, 8, 11, 12, 13 and ~~13~~14). *Piping* losses shall not be modeled in either the *proposed design* or *baseline building design* for hot-water, chilled-water, or steam *piping*.

G3.2.3.7 Type and Number of Chillers (Systems 7, 8, 11, 12, 13 and ~~13~~14). Electric chillers shall be used in the *baseline building design* regardless of the cooling *energy* source, e.g. direct-fired absorption or absorp- tion from purchased steam. The *baseline building design*'s chiller plant shall be modeled with chillers hav- ing the number and type as indicated in Table G3.2.3.7 based on the peak coincident cooling load of baseline *HVAC systems* using chilled water.

Exception to G3.2.3.7: *Systems* using purchased chilled water shall be modeled in accordance with Section G3.2.1.6.

G3.2.3.8 Chilled-Water Design Supply Temperature (Systems 7, 8, 11, 12, 13 and ~~13~~14). Chilled-water design supply temperature shall be modeled at 44°F6.7°C and return water temperature at 56°F13°C.

G3.2.3.9 Chilled-Water Supply Temperature Reset (Systems 7, 8, 11, 12, 13 and ~~13~~14). Chilled-water supply temperature shall be *reset* based on outdoor dry-bulb temperature using the following schedule: 44°F7°C at 80°F27°C and above, 54°F12°C at 60°F16°C and below, and ramped linearly between 44°F7°C and 54°F12°C at temperatures between 80°F27°C and 60°F16°C.

Exception to G3.2.3.9:

1. If the baseline chilled-water *system* serves a *computer room HVAC system*, the supply chilled- water temperature shall be *reset* higher based on the *HVAC system* requiring the most cooling; i.e., the chilled-water *set point* is *reset* higher until one cooling-coil valve is nearly wide open. The maximum *reset* chilled-water supply temperature shall be 54°F12°C.
2. *Systems* served by purchased chilled water.**G3.2.3.10 Chilled-Water Pumps (Systems 7, 8, 11, 12, 13 and ~~13~~14).** Chilled-water *systems* shall be mod- eled as primary/secondary *systems* with constant-flow primary loop and variable-flow secondary loop. For *systems* with cooling capacity of 300 tons1055 kW or more, the secondary *pump* shall be modeled with variable- speed drives and a minimum flow of 25% of the design flow rate. Chilled-water *pumps* shall only be enabled when a load exists on the associated chilled-water loop. For *systems* with less than 300 tons1055 kW cooling capacity, the secondary *pump* shall be modeled as riding the *pump* curve. The baseline *building* constant-volume primary *pump* power shall be modeled as 9 W/gpm140 W·s/L, and the variable-flow secondary *pump* power shall be modeled as 13 W/gpm 210 W·s/L at *design conditions*. For *computer room systems* using *System* 11 or 12 with an integrated *fluid economizer*, the *baseline building design* primary chilled-water *pump* power shall be increased by 3 W/gpm48 W·s/L for flow associated with the *fluid economizer*.

Exception to G3.2.3.10: For *systems* using purchased chilled water, the *building* distribution *pump* shall be modeled with variable-speed drive, a minimum flow of 25% of the design flow rate, and a *pump* power of 16 W/gpm250 kW/1000 L/s.

G3.2.3.11 Heat Rejection (Systems 7, 8, 11, 12, 13 and ~~13~~14). 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/hp3.23 L/s·kW at the conditions specified in Table 6.8.1-7. Condenser-water design supply temperature shall be calculated using the cooling tower approach to the 0.4% *evaporation design wet-bulb temperature* as generated by the formula below, with a design temperature rise of 10°F5.6°C:

$$\text{Approach}_{10°F5.6°C}\ \text{Range} = 25.72\ 10.02 - (0.24 \times \text{WB})$$

where WB is the 0.4% *evaporation design wet-bulb temperature* (°F°C); valid for wet bulbs from 55°F to 90°F12.8°C to 32.2°C.

The tower shall be controlled to maintain a leaving water temperature, where weather permits, per Table G3.2.3.11, floating up to the design leaving water temperature for the cooling tower. The *baseline building design* condenser-water *pump* power shall be 19 W/gpm300 W·s/L and modeled as constant volume. For *computer room systems* using *System* 11 or 12 with an integrated *fluid economizer*, the *baseline building design* condenser- water-*pump* power shall be increased by 3 W/gpm48 kW/1000 L/s for flow associated with the *fluid economizer*. Each chiller shall be modeled with separate condenser-water and chilled-water *pumps* interlocked to operate with
the associated chiller.

G3.2.3.12 Supply Air Temperature Reset (Systems 5 through 8, 11 and ~~11~~12). The air temperature for cooling shall be *reset* higher by 5°F2.3°C under the minimum cooling load conditions.

G3.2.3.15 VAV Fan Part-Load Performance (Systems 5 through 8, 11 and ~~11~~12). *VAV system* supply fans shall have variable-speed drives, and their part-load performance characteristics shall be modeled using either Method 1 or Method 2 specified in Table G3.2.3.15.

G3.2.3.17 System 11 and 12 Supply Air Temperature and Fan Control. Minimum volume *set point* shall be 50% of the maximum design airflow rate, the minimum *ventilation* outdoor airflow rate, or the airflow rate required to comply with applicable codes or accreditation standards, whichever is larger.

Fan volume shall be *reset* from 100% airflow at 100% cooling load to minimum airflow at 50% cooling load. Supply air temperature *set point* shall be *reset* from minimum supply air temperature at 50% cooling load and above to *space* temperature at 0% cooling load. In heating mode supply air temperature shall be modulated to maintain *space* temperature, and fan volume shall be fixed at the minimum airflow.

G3.2.3.18 Dehumidification (Systems 3 through 8 and 11, 12, 13 and ~~13~~14). If the *proposed design HVAC systems* have *humidistatic controls*, then the *baseline building design* shall use *mechanical cooling* for dehumidification and shall have *reheat* available to avoid overcooling. When the *baseline building design HVAC system* does not comply with any of the exceptions in Section 6.5.2.3, then only 25% of the *system reheat energy* shall be included in the *baseline building performance*. The *reheat* type shall be the same as the *sys- tem* heating type.

Table G3.1.1-3 Baseline HVAC System Types

Building Area Types [a], Number of Stories [b], and Combined Floor Area [c]	**Climate Zones 3B, 3C, and 4 to 8**	**Climate Zones 0 to 3A**
Residential	*System* 1—*PTAC*	*System* 2—*PTHP*
Public assembly area smaller than 120,000 ft^2 11,000 m^2	*System* 3—PSZ-AC	*System* 4—PSZ-HP
Public assembly area equal to or larger than 120,000 ft^2 11,000 m^2	*System* ~~12~~13—SZ-CV-HW	*System* ~~13~~14—SZ-CV-ER
Heated-only storage	*System* 9—Heating and *ventilation*	*System* 10—Heating and *ventilation*
Retail in a *building* that is 1 or 2 *stories*	*System* 3—PSZ-AC	*System* 4—PSZ-HP
Hospital that is either • larger than 150,000 ft^2 or • in a *building* greater than 5 *stories*.	*System* 7—*VAV* with *reheat*	*System* 7—*VAV* with *reheat*
Hospital—all other	*System* 5—Packaged *VAV* with *reheat*	*System* 5—Packaged *VAV* with *reheat*
Other *Nonresidential* area that is both • smaller than 25,000 ft^{2}2300m^{2}and • in a *building* 3 *stories* or fewer.	*System* 3—PSZ-AC	*System* 4—PSZ-HP
Other *Nonresidential* area that is both • smaller than 25,000 ft^{2}2300 m^{2}and • in a *building* with 4 or 5 *stories*.	*System* 5—Packaged *VAV* with *reheat*	*System* 6—Packaged *VAV* with PFP boxes
Other *nonresidential* area that is both • 25,000 ft^{2}2300m^2 to 150,000 ft^{2}14,000m^2 and • in a *building* that is 5 *stories* or fewer.	*System* 5—Packaged *VAV* with *reheat*	*System* 6—Packaged *VAV* with PFP boxes
Other *Nonresidential* area that is either • larger than 150,000 ft^{2}14,000 m^2 or • in a *building* greater than 5 *stories*.	*System* 7—*VAV* with *reheat*	*System* 8—*VAV* with PFP boxes

a. *Building* area type determined in accordance with Section G3.2.1.1.
b. The total number of *stories* in a *building,* including above-grade and below-grade *stories* but not including *stories* solely devoted to parking.
c. Combined *gross conditioned floor area* and *semiheated floor area,* of the *building* area type, based on the requirements of Section G3.2.1.1.

Table G3.1.1-4 Baseline System Descriptions

System No.	System Type	Fan Control	Cooling Type [a]	Heating Type [a]
1. *PTAC*	*Packaged terminal air conditioner*	Constant volume	Direct expansion	Hot-water *fossil fuel boiler*
2. *PTHP*	*Packaged terminal heat pump*	Constant volume	Direct expansion	Electric heat pump
3. PSZ-AC	Packaged rooftop air conditioner	Constant volume	Direct expansion	*Fossil fuel* furnace
4. PSZ-HP	Packaged rooftop heat pump	Constant volume	Direct expansion	Electric heat pump
5. Packaged *VAV* with *reheat*	Packaged rooftop *VAV* with *reheat*	*VAV*	Direct expansion	Hot-water *fossil fuel boiler*
6. Packaged *VAV* with PFP boxes	Packaged rooftop *VAV* with parallel fan power boxes and *reheat*	*VAV*	Direct expansion	*Electric resistance*
7. *VAV* with *reheat*	*VAV* with *reheat*	*VAV*	Chilled water	Hot-water *fossil fuel boiler*
8. *VAV* with PFP boxes	*VAV* with parallel fan-powered boxes and *reheat*	*VAV*	Chilled water	*Electric resistance*
9. Heating and *ventilation*	Warm air furnace, gas fired	Constant volume	None	*Fossil fuel* furnace
10.Heating and *ventilation*	Warm air furnace, electric	Constant volume	None	*Electric resistance*
11.SZ–*VAV*-*HW*	Single-zone *VAV*	*VAV*	Chilled water	~~See note (b).~~ Hot-water *fossil fuel boiler*
12.SZ-VAV-ER	Single-zone *VAV*	*VAV*	Chilled water	Electric resistance
~~12~~13.SZ-CV-HW	*Single-zone system*	Constant volume	Chilled water	Hot-water *fossil fuel boiler*
~~13~~14.SZ-CV-ER	*Single-zone system*	Constant volume	Chilled water	*Electric resistance*

a. For purchased chilled water and purchased heat, see Section G3.2.1.3.

~~b. For Climate Zones 0 through 3A, the heating type shall be *electric resistance*. For all other climate zones the heating type shall be hot-water fossil *fuel boiler.*~~

Table G3.2.2.5 Climate Conditions under which Economizers are Included for Comfort Cooling for Baseline Systems 3 through 8 and 11, 12, 13 and ~~13~~14

Climate Zone
0A, 0B, 1A, 1B, 2A, 3A, 4A
Others

Note: NR means that there is no conditioned *building* floor area for which economizers are included for the type of zone and climate.

Table G3.2.2.8 Baseline Fan Brake Horsepower

Baseline Fan Motor Brake Horsepower		
Constant-Volume Systems 3, 4, ~~12~~13, and ~~13~~14	**Variable-Volume Systems 5 to 8**	**Variable-Volume System 11 or 12**
$CFM_s \times 0.00094 + A$	$CFM_s \times 0.0013 + A$	$CFM_s \times 0.00062 + A$

Notes:

1. Where *A* is calculated according to Section 6.5.3.1.1 using the pressure-drop adjustment from the *proposed design* and the design flow rate of the baseline *building system*. Do not include pressure-drop adjustments for evaporative coolers or heat recovery devices that are not required in the baseline *building system* by Section G3