ADDENDA

ANSI/ASHRAE/IES Addendum bp to
ANSI/ASHRAE/IES Standard 90.1-2022

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on April 30, 2025, and by the Illuminating Engineering Society on March 31, 2025.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

 ISSN 1041-2336

Approved American National Standard
www.ansi.org

SPECIAL NOTE

This American National Standard (ANS) is a national voluntary consensus Standard developed under the auspices of ASHRAE. *Consensus* is defined by the American National Standards Institute (ANSI), of which ASHRAE is a member and which has approved this Standard as an ANS, as "substantial agreement reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made toward their resolution." Compliance with this Standard is voluntary until and unless a legal jurisdiction makes compliance mandatory through legislation.

ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

The Senior Manager of Standards of ASHRAE should be contacted for

a. interpretation of the contents of this Standard,
b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard, or
d. permission to reprint portions of the Standard.

(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

Addendum bp removes the mechanical performance factors (MPFs) from the total system performance ratio (TSPR) calculation found in Section 6.6.2 of Standard 90.1. The stringency of TSPR remains unchanged.

MPFs were originally calculated as the ratio of the target HVAC system TSPR (representing good standard, current practice) to the reference HVAC TSPR (same system type as the applicable Appendix G baseline system type). The target system for each building type and climate zone was developed by Standing Standard Project Committee (SSPC) 90.1, as documented in a Pacific National Northwest Laboratory (PNNL) technical report.[1]

$$\text{MPF} = TSPR_r/TSPR_t$$

Compliance with Section 6.6.2 required the following:

$$TSPR_p \geq TSPR_r/\text{MPF}$$

where

$TSPR_t$ = *target TSPR*

$TSPR_r$ = *reference TSPR*

$TSPR_p$ = *proposed TSPR*

MPF = *mechanical performance factor based on climate zone and building use type*

With the new approach, there is no longer a need for separate target and reference systems. For simplicity, what was originally referred to as the target system will now just be referred to as the reference system and compliance now only requires the following:

$$TSPR_p \geq TSPR_r$$

Where the reference system now represents "good, standard, current practice" as described in the updated Normative Appendix L in this addendum. This addendum to the standard is an approach designed to provide increased flexibility and therefore was not subjected to cost effectiveness analysis.

Informative 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 bp to Standard 90.1-2022

Modify Section 3.3 as follows.

3.3 Abbreviations and Acronyms

~~MPF~~ ~~mechanical performance factor~~

Modify Section 6 as follows.

6. HEATING, VENTILATING, AND AIR CONDITIONING

[. . .]

6.6.2 Mechanical System Performance Path

6.6.2.1 Scope. The Mechanical System Performance Path is an optional path for compliance where the following conditions are met:

a. All *HVAC systems* in the *building* that meet the criteria in Section L1.1.1 shall comply with Section 6.6.2.2.

b. All other HVAC *systems* shall comply with one of the following:

   1. HVAC *systems* shall comply with the applicable requirements in Section 6.5.

1. www.energycodes.gov/sites/default/files/2023-02/TechDoc_901-TSPR_2021oct21.pdf

2. *HVAC systems* that only serve the heating, cooling, or ventilating needs of a *computer room* with IT *equipment* load greater than 10 kW shall be permitted to comply with ANSI/ASHRAE Standard 90.4, *Energy Standard for Data Centers*.

6.6.2.2 Criteria. *HVAC systems* in new *buildings*, *additions*, or *alterations* shall comply with the requirements in Section L2, "Mechanical System Performance Rating Method." The *proposed design total system performance ratio* ($TSPR_p$) of the *HVAC systems* using this method shall be greater than or equal to the *total system performance ratio* of the *TSPR reference building design* ($TSPR_r$) ~~divided by the mechanical performance factor (MPF)~~ when calculated in accordance with the following:

$$TSPR_p > TSPR_r / MPF$$

where

$TSPR_p$ = proposed *TSPR* calculated in accordance with Normative Appendix L

$TSPR_r$ = reference *TSPR* calculated in accordance with Normative Appendix L

~~MPF = mechanical performance factor from Table 6.6.2.2 based on climate zone and *building* use type~~

~~Where a *building* has multiple *building* use types, MPF shall be area weighted as follows:~~

$$MPF = (A_1 \times MPF_1 + A_2 \times MPF_2 + \ldots + A_n \times MPF_n)/(A_1 + A_2 + \ldots + A_n)$$

~~where~~

$MPF_1, MPF_2, \ldots, MPF_n$ = ~~mechanical performance factors from Table 6.6.2.2 based on climate zone and *building* use types 1 through *n*~~

$A_1, A_2, \ldots, An$ = ~~*gross conditioned floor areas* for *building* use types 1 through *n*~~

Delete Table 6.6.2.2.

~~**Table 6.6.2.2 Mechanical Performance Factors (MPF)**~~

~~Building Type~~	~~Climate Zone~~																	
	~~0A~~	~~0B~~	~~1A~~	~~1B~~	~~2A~~	~~2B~~	~~3A~~	~~3B~~	~~3C~~	~~4A~~	~~4B~~	~~4C~~	~~5A~~	~~5B~~	~~5C~~	~~6A~~	~~6B~~	~~7~~	~~8~~
~~Office (small and medium)[a]~~	~~0.72~~	~~0.71~~	~~0.70~~	~~0.70~~	~~0.68~~	~~0.65~~	~~0.71~~	~~0.66~~	~~0.62~~	~~0.69~~	~~0.64~~	~~0.65~~	~~0.72~~	~~0.66~~	~~0.65~~	~~0.74~~	~~0.70~~	~~0.75~~	~~0.77~~
~~Office (large)[a]~~	~~0.83~~	~~0.83~~	~~0.84~~	~~0.84~~	~~0.79~~	~~0.82~~	~~0.72~~	~~0.84~~	~~0.78~~	~~0.69~~	~~0.80~~	~~0.67~~	~~0.72~~	~~0.75~~	~~0.67~~	~~0.73~~	~~0.73~~	~~0.71~~	~~0.70~~
~~Retail~~	~~0.60~~	~~0.57~~	~~0.50~~	~~0.55~~	~~0.46~~	~~0.46~~	~~0.43~~	~~0.46~~	~~0.38~~	~~0.40~~	~~0.45~~	~~0.48~~	~~0.41~~	~~0.50~~	~~0.47~~	~~0.44~~	~~0.39~~	~~0.40~~	~~0.36~~
~~Hotel/motel~~	~~0.62~~	~~0.62~~	~~0.63~~	~~0.63~~	~~0.62~~	~~0.68~~	~~0.61~~	~~0.71~~	~~0.73~~	~~0.59~~	~~0.66~~	~~0.65~~	~~0.55~~	~~0.59~~	~~0.68~~	~~0.51~~	~~0.54~~	~~0.47~~	~~0.40~~
~~Multifamily/ dormitory~~	~~0.64~~	~~0.63~~	~~0.67~~	~~0.63~~	~~0.65~~	~~0.64~~	~~0.59~~	~~0.68~~	~~0.54~~	~~0.59~~	~~0.57~~	~~0.52~~	~~0.58~~	~~0.53~~	~~0.48~~	~~0.57~~	~~0.53~~	~~0.55~~	~~0.52~~
~~School/education~~	~~0.82~~	~~0.81~~	~~0.80~~	~~0.79~~	~~0.75~~	~~0.72~~	~~0.71~~	~~0.72~~	~~0.68~~	~~0.67~~	~~0.71~~	~~0.65~~	~~0.72~~	~~0.68~~	~~0.60~~	~~0.75~~	~~0.69~~	~~0.72~~	~~0.68~~

~~a. Office sizes defined in Section L1.1.1.1.~~

Modify Section 11 as follows.

11. ADDITIONAL EFFICIENCY REQUIREMENTS

[. . .]

11.5.2.2.1 H01: HVAC System Performance Improvement. For systems allowed to use Section 6.6.2, "Mechanical System Performance Path," the savings ($TSPR_{sav}$) from the proposed *TSPR* compared to the $TSPR_r$ ~~/MPF~~ calculated in accordance with Normative Appendix L and Section 6.6.2.2. shall be 5% or more. Where the improvement is more than 5%, base energy credits from Tables 11.5.3-1 through 11.5.3-9 are permitted to be prorated up to a 20% improvement as follows:

$$EC_{H01\_adj} = EC_{H01\_base} \times \frac{TSPR_{sav}}{0.05} \times Area_{TSPR}$$

The range of allowed credit adjustment shall be limited as follows:

$$0.05 \le TSPR_{sav} \le 0.20$$

where:

EC_{H01_adj} = energy credits achieved for improved mechanical system performance

EC_{H01_base} = H01 base energy credit from Section 11.5.3

~~$TSPR_{sav}$ = $1 - (TSPR_r / MPF) / TSPR_p$~~

$\underline{TSPR_{sav}} = \underline{1 - \frac{TSPR_r}{TSPR_p}}$

where:

$TSPR_p$ = proposed *TSPR* calculated in accordance with Normative Appendix L

$TSPR_r$ = reference *TSPR* calculated in accordance with Normative Appendix L

~~MPF = mechanical performance factor from Table 6.6.2.2 based on climate zone and *building* use type. Where a *building* has multiple *building* use types, MPF shall be area weighted as described in Section 6.6.2.2.~~

$Area_{TSPR}$ = [floor area in *TSPR* calculation]/[total conditioned building floor area]

Modify Appendix L as follows.

NORMATIVE APPENDIX L
MECHANICAL SYSTEM PERFORMANCE RATING METHOD

Table L4.3.2-1 TSPR Reference Building Design HVAC Complex Systems (I-P)

Building Type Parameter	Large Office (warm) [a] Climate Zones 0 to 2 and 3A	Large Office (cold) [b] Climates Zones 3B, 3C, and 4 to 8	School (warm) [a] Climate Zones 0 to 2 and 3A	School (cold) [b] Climates Zones 3B, 3C, and 4 to 8
System type	VAV/reheat water-cooled chiller/ electric reheat with parallel fan powered boxes	VAV/reheat water-cooled chiller/ gas boiler	VAV/reheat water-cooled chiller/ electric reheat with parallel fan powered boxes	VAV/reheat water-cooled chiller/ gas boiler
Fan control	VSD, ~~no~~ with static pressure reset	VSD, ~~no~~ with static pressure reset	VSD, ~~no~~ with static pressure reset	VSD, ~~no~~ with static pressure reset
Main fan power (W/cfm) proposed ≥MERV13	~~1.165~~ 1.127	~~1.165~~ 1.127	~~1.165~~ 1.127	~~1.165~~ 1.127
Main fan power (W/cfm) proposed <MERV13	~~1.066~~ 1.030	~~1.066~~ 1.030	~~1.066~~ 1.030	~~1.066~~ 1.030
Zonal fan power, W/cfm	0.35	NA	0.35	NA
Minimum zone airflow fraction[c]	1.5 × V_{oz}	1.5 × V_{oz}	1.2 × V_{oz}	1.2 × V_{oz}
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Outdoor air economizer	~~No~~ Yes except 0–1	Yes ~~except 4A~~	~~No~~ Yes except 0–1	Yes ~~except 4A~~
Outdoor air economizer control	Where economizer: Differential dry-bulb temperature in 6A, 5A, all B and C climate zones; lockout on fixed enthalpy >28 Btu/lb or fixed dry-bulb OAT > 75°F (24°C) in 0A to 4A climate zones			
Occupied *outdoor air* (= proposed)[c]	Sum(V_{oz})/0.75	Sum(V_{oz})/0.75	Sum(V_{oz})/0.65	Sum(V_{oz})/0.65
Energy recovery ventilator *enthalpy recovery ratio* bypass; SAT set point	NA	NA	50%; no bypass	50%; 60°F except no bypass required in Climate Zone 4A
Demand control ventilation	~~No~~ Yes	~~No~~ Yes	~~No~~ Yes	~~No~~ Yes
Cooling source	2 water-cooled centrif. chillers	2 water-cooled centrif. chillers	2 water-cooled screw chillers	2 water-cooled screw chillers
Cooling *efficiency*	~~Table G3.5.3~~ Table 6.8.1-3, Path B, for profile >300 tons	~~Table G3.5.3~~ Table 6.8.1-3, Path B, for profile >300 tons	~~Table G3.5.3~~ Table 6.8.1-3, Path B, for profile 150–300 ton	~~Table G3.5.3~~ Table 6.8.1-3, Path B, for profile 150–300 ton
Heating source (*reheat*)	Electric resistance	Gas boiler	Electric resistance	Gas boiler
Furnace or boiler *efficiency*	1.0	~~75~~ 90% E_t	1.0	80% E_t
Condenser heat rejection	Axial-fan open-circuit cooling tower			
Cooling-tower *efficiency*, gpm/hp ~~(See Section G3.2.3.11)~~	~~38.2~~ Value in Table 6.8.1-7	~~38.2~~ Value in Table 6.8.1-7	~~38.2~~ Value in Table 6.8.1-7	~~38.2~~ Value in Table 6.8.1-7
Open-circuit cooling-tower turndown (>300 ton)	50%	50%	50%	50%

a. "Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
c. V_{oz} is the zone minimum outdoor airflow rate as defined in ASHRAE Standard 62.1.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-1 TSPR Reference Building Design HVAC Complex Systems (I-P) *(Continued)*

Building Type Parameter	Large Office (warm) [a] Climate Zones 0 to 2 and 3A	Large Office (cold) [b] Climates Zones 3B, 3C, and 4 to 8	School (warm) [a] Climate Zones 0 to 2 and 3A	School (cold) [b] Climates Zones 3B, 3C, and 4 to 8
Pump (constant flow/variable flow; range)	Constant flow; 10°F range	Constant flow; 10°F range	Constant flow; 10°F range	Constant flow; 10°F range
Open-circuit cooling-tower approach and leaving water temperature	G3.2.3.11	G3.2.3.11	G3.2.3.11	G3.2.3.11
Cooling condenser *pump* power, W/gpm	19	19	19	19
Cooling primary *pump* power, W/gpm	9	9	9	9
Cooling secondary *pump* power, W/gpm	13	13	13	13
Cooling-coil CHW temperature difference, °F	~~12~~ 18	~~12~~ 18	~~12~~ 18	~~12~~ 18
Design CHWST, °F	~~44~~ 42	~~44~~ 42	~~44~~ 42	~~44~~ 42
CHWST *reset set point* vs. OAT, °F	CHWST/OAT: 42~~44~~–54/80–60 (See Normative Appendix G.)	CHWST/OAT: 42~~44~~–54/80–60 (See Normative Appendix G.)	CHWST/OAT: 42~~44~~–54/80–60 (See Normative Appendix G.)	CHWST/OAT: 42~~44~~–54/80–60 (See Normative Appendix G.)
CHW-loop pumping control	Two-way valves and *pump* VSD	Two-way valves and *pump* VSD	Two-way valves and *pump* VSD	Two-way valves and *pump* VSD
Heating-*pump* power, W/gpm	~~16.1~~ NA	16.1	~~16.1~~ NA	16.1
Heating-coil HW temperature difference, °F	~~50~~ NA	~~50~~ 20	~~50~~ NA	50
Design HWST, °F	~~180~~ NA	~~180~~ 140	~~180~~ NA	180
HWST *reset set point* vs. OAT, °F	~~HWST/OAT: 180–150/20–50~~ NA	HWST/OAT: 1~~8~~40–1~~50~~120/20–50	~~HWST/OAT: 180–150/20–50~~ NA	HWST/OAT: 180–150/20–50
HW-loop pumping control	~~Two-way valves and *pump* VSD~~ NA	Two-way valves and *pump* VSD	~~Two-way valves and *pump* VSD~~ NA	Two-way valves and *pump* VSD

a. "Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
c. V_{oz} is the zone minimum outdoor airflow rate as defined in ASHRAE Standard 62.1.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-1 TSPR Reference Building Design HVAC Complex Systems (SI)

Building Type Parameter	Large Office (warm) [a] Climate Zones 0 to 2 and 3A	Large Office (cold) [b] Climates Zones 3B, 3C, and 4 to 8	School (warm) [a] Climate Zones 0 to 2 and 3A	School (cold) [b] Climates Zones 3B, 3C, and 4 to 8
System type	VAV/reheat water-cooled chiller/ electric reheat with parallel fan powered boxes	VAV/reheat water-cooled chiller/ gas boiler	VAV/reheat water-cooled chiller/ electric reheat with parallel fan powered boxes	VAV/reheat water-cooled chiller/ gas boiler
Fan control	VSD, ~~no~~ with static pressure reset	VSD, ~~no~~ with static pressure reset	VSD, ~~no~~ with static pressure reset	VSD, ~~no~~ with static pressure reset
Main fan power (W·s/L) proposed ≥MERV13	~~1.165~~ 1.127	~~1.165~~ 1.127	~~1.165~~ 1.127	~~1.165~~ 1.127
Main fan power (W·s/L) proposed <MERV13	~~1.066~~ 1.030	~~1.066~~ 1.030	~~1.066~~ 1.030	~~1.066~~ 1.030
Zonal fan power, W·s/L	0.35	NA	0.35	NA
Minimum zone airflow fraction[c]	1.5 × V_{oz}	1.5 × V_{oz}	1.2 × V_{oz}	1.2 × V_{oz}
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Outdoor air economizer	~~No~~ Yes except 0–1	Yes ~~except 4A~~	~~No~~ Yes except 0–1	Yes ~~except 4A~~
Outdoor air economizer control	Where economizer: Differential dry-bulb temperature in 6A, 5A, all B and C climate zones; lockout on fixed enthalpy >65.1 kJ/kg or fixed dry-bulb OAT > 24°C in 0A to 4A climate zones			
Occupied *outdoor air* (= proposed)[c]	Sum(V_{oz})/0.75	Sum(V_{oz})/0.75	Sum(V_{oz})/0.65	Sum(V_{oz})/0.65
Energy recovery ventilator *enthalpy recovery ratio* bypass; SAT set point	NA	NA	50%; no bypass	50%; 15.6°C except no bypass required in Climate Zone 4A
Demand control ventilation	~~No~~ Yes	~~No~~ Yes	~~No~~ Yes	~~No~~ Yes
Cooling source	2 water-cooled centrif. chillers	2 water-cooled centrif. chillers	2 water-cooled screw chillers	2 water-cooled screw chillers
Cooling *efficiency*	~~Table G3.5.3~~ Table 6.8.1-3, Path B, for profile >1060 kW	~~Table G3.5.3~~ Table 6.8.1-3, Path B, for profile >1060 kW	~~Table G3.5.3~~ Table 6.8.1-3, Path B, for profile 530–1060 kW	~~Table G3.5.3~~ Table 6.8.1-3, Path B, for profile 530–1060 kW
Heating source (*reheat*)	Electric resistance	Gas boiler	Electric resistance	Gas boiler
Furnace or boiler *efficiency*	1.0	~~75~~ 90% E_t	1.0	80% E_t
Condenser heat rejection	Axial-fan open-circuit cooling tower			
Cooling-tower *efficiency*, L/s·kW ~~(See Section G3.2.3.11)~~	~~3.23~~ Value in Table 6.8.1-7	~~3.23~~ Value in Table 6.8.1-7	~~3.23~~ Value in Table 6.8.1-7	~~3.23~~ Value in Table 6.8.1-7
Open-circuit cooling-tower turndown (>1060 kW)	50%	50%	50%	50%
Pump (constant flow/variable flow; range)	Constant flow; 5.6°C range	Constant flow; 5.6°C range	Constant flow; 5.6°C range	Constant flow; 5.6°C range
Open-circuit cooling-tower approach and leaving water temperature	G3.2.3.11	G3.2.3.11	G3.2.3.11	G3.2.3.11

a. "Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
c. V_{oz} is the zone minimum outdoor airflow rate as defined in ASHRAE Standard 62.1.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-1 TSPR Reference Building Design HVAC Complex Systems (SI) *(Continued)*

Building Type Parameter	Large Office (warm) [a] Climate Zones 0 to 2 and 3A	Large Office (cold) [b] Climates Zones 3B, 3C, and 4 to 8	School (warm) [a] Climate Zones 0 to 2 and 3A	School (cold) [b] Climates Zones 3B, 3C, and 4 to 8
Cooling condenser *pump* power, W·s/L	300	300	300	300
Cooling primary *pump* power, W·s/L	142	142	142	142
Cooling secondary *pump* power, W·s/L	205	205	205	205
Cooling-coil CHW temperature difference, °C	~~6.7~~ 10	~~6.7~~ 10	~~6.7~~ 10	~~6.7~~ 10
Design CHWST, °C	~~6.7~~5.6	~~6.7~~5.6	~~6.7~~5.6	~~6.7~~5.6
CHWST *reset set point* vs. OAT, °C	CHWST/OAT: ~~6.7~~5.6–12.2/26.7–15.6 (See Normative Appendix G.)	CHWST/OAT: ~~6.7~~5.6–12.2/26.7–15.6 (See Normative Appendix G.)	CHWST/OAT: ~~6.7~~10–12.2/26.7–15.6 (See Normative Appendix G.)	CHWST/OAT: ~~6.7~~10–12.2/26.7–15.6 (See Normative Appendix G.)
CHW-loop pumping control	Two-way valves and *pump* VSD	Two-way valves and *pump* VSD	Two-way valves and *pump* VSD	Two-way valves and *pump* VSD
Heating-*pump* power, W·s/L	~~254~~ NA	254	~~254~~ NA	254
Heating-coil HW temperature difference, °C	~~10~~ NA	~~10~~ 20	~~10~~ NA	~~10~~ 27.8
Design HWST, °C	~~82~~ NA	~~82~~ 60	~~82~~ NA	82
HWST *reset set point* vs. OAT, °C	~~HWST/OAT: 82–65.6/6.7–10~~ NA	HWST/OAT: ~~82–65.6~~6 60–48.9/–6.7–10	~~HWST/OAT: 82–65.6/6.7–10~~ NA	HWST/OAT: 82–65.6/–6.7–10
HW-loop pumping control	~~Two-way valves and *pump* VSD~~ NA	Two-way valves and *pump* VSD	~~Two-way valves and *pump* VSD~~ NA	Two-way valves and *pump* VSD

a. "Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
c. V_{oz} is the zone minimum outdoor airflow rate as defined in ASHRAE Standard 62.1.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-2 TSPR Reference Building Design HVAC Simple Systems 1 (I-P)

Building Type Parameter	Medium Office (warm) [a]	Medium Office (cold) [b]	Small Office (warm) [a]	Small Office (cold) [b]	Retail (warm) [a]	Retail (cold) [b]
System type	Package *VAV*—electric *reheat*	Package *VAV*—hydronic *reheat*	PSZ-HP	PSZ-AC	PSZ-HP	PSZ-AC
Fan control	VSD, ~~no~~ with static pressure reset	VSD, ~~no~~ with static pressure reset	Constant volume	Constant volume	~~Constant volume~~ 2-speed	~~Constant volume~~ 2-speed
Main fan power (W/cfm) proposed ≥MERV13	~~1.285~~ 0.634	~~1.285~~ 0.634	~~0.916~~ 0.486	~~0.916~~ 0.486	~~0.899~~ 0.585	~~0.899~~ 0.585
Main fan power (W/cfm) proposed <MERV13	~~1.176~~ 0.528	~~1.176~~ 0.528	~~0.850~~ 0.423	~~0.850~~ 0.423	~~0.835~~ 0.522	~~0.835~~ 0.522
Zonal fan power (W/cfm)	0.35	NA	NA	NA	NA	NA
Minimum zone airflow fraction [c]	~~30%~~ $1.5 \times V_{oz}$	~~30%~~ $1.5 \times V_{oz}$	NA	NA	NA	NA
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	NA	NA	<40°F OAT	NA	<40°F OAT	NA
Outdoor air economizer	~~No~~ Yes except 0–1	Yes ~~except 4A~~	~~No~~ Yes except 0–1	Yes ~~except 4A~~	~~No~~ Yes except 0–1	Yes ~~except 4A~~
Outdoor air economizer control	Where economizer: Differential dry-bulb temperature in 6A, 5A, all B and C climate zones; lockout on fixed enthalpy >28 Btu/lb or fixed dry-bulb OAT > 75°F in 0A to 4A climate zones					
Occupied *outdoor air* source	Packaged unit, occupied damper, all *building* use types					
Energy recovery ventilator *enthalpy recovery ratio* ; bypass; SAT set point, °F	No	No	No	No	~~No~~ Yes, in 0A, 1A, 2A, 3A, 50%, 60°F in 2A and 3A	~~No~~ Yes, all A, 6, 7, 8 50%, 60°F
Demand control ventilation	~~No~~ Yes	~~No~~ Yes	No	No	~~No~~ Yes	~~No~~ Yes
% Area variable control	15%	15%			80%	80%
% Area on/off control	65%	65%			0%	0%
Cooling source	DX, multistage	DX, multistage	DX, single stage (heat pump)	DX, single stage	DX, ~~single~~ 2 stage (heat pump)	DX, ~~single~~ 2 stage
Cooling *COP* (net of fan)	~~3.40~~ 3.83	~~3.40~~ 3.83	~~3.00~~ 3.82	~~3.00~~ 3.82	~~3.40~~ 3.76	~~3.50~~ 3.76
Heating source	*Electric resistance*	Gas *boiler*	Heat pump	Furnace	Heat pump	Furnace
Heating *COP* (net of fan)/furnace or *boiler efficiency*	1.0	~~75~~ 81% E_t	~~3.40~~ 3.81	8~~0~~1% E_t	~~3.40~~ 3.54	8~~0~~1% E_t
Heating-*pump* power, W/gpm	NA	16.1	NA	NA	NA	NA
Heating-coil HW temperature difference, °F	NA	50	NA	NA	NA	NA

a. Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
c. V_{oz} is the zone minimum outdoor airflow rate as defined in ASHRAE Standard 62.1.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-2 TSPR Reference Building Design HVAC Simple Systems 1 (I-P) *(Continued)*

Building Type Parameter	Medium Office (warm) [a]	Medium Office (cold) [b]	Small Office (warm) [a]	Small Office (cold) [b]	Retail (warm) [a]	Retail (cold) [b]
Design HWST, °F	NA	180	NA	NA	NA	NA
HWST *reset set point* vs. OAT, °F	NA	HWST/OAT: 180–150/20–50	NA	NA	NA	NA
HW-loop pumping control	NA	2-way valves ride the pump curve	NA	NA	NA	NA

a. Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
c. V_{oz} is the zone minimum outdoor airflow rate as defined in ASHRAE Standard 62.1.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-2 TSPR Reference Building Design HVAC Simple Systems 1 (SI)

Building Type Parameter	Medium Office (warm) [a]	Medium Office (cold) [b]	Small Office (warm) [a]	Small Office (cold) [b]	Retail (warm) [a]	Retail (cold) [b]
System type	Package *VAV*—electric *reheat*	Package *VAV*—hydronic *reheat*	PSZ-HP	PSZ-AC	PSZ-HP	PSZ-AC
Fan control	VSD, ~~no~~ with static pressure reset	VSD, ~~no~~ with static pressure reset	Constant volume	Constant volume	~~Constant volume~~ 2-speed	~~Constant volume~~ 2-speed
Main fan power (W·s/L) proposed ≥MERV13	~~20.29~~ 1.343	~~20.29~~ 1.343	~~14.46~~ 1.03	~~14.46~~ 1.03	~~14.19~~ 1.240	~~14.19~~ 1.240
Main fan power (W·s/L) proposed <MERV13	~~18.59~~ 1.119	~~18.59~~ 1.119	~~13.42~~ 0.896	~~13.42~~ 0.896	~~13.42~~ 1.106	~~13.42~~ 1.106
Zonal fan power, W·s/L	0.35	NA	NA	NA	NA	NA
Minimum zone airflow fraction [c]	~~30%~~ 1.5 × V_{oz}	~~30%~~ 1.5 × V_{oz}	NA	NA	NA	NA
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	NA	NA	<40°F OAT	NA	<40°F OAT	NA
Outdoor air economizer	~~No~~ Yes except 0–1	Yes ~~except 4A~~	~~No~~ Yes except 0–1	Yes ~~except 4A~~	~~No~~ Yes except 0–1	Yes ~~except 4A~~
Outdoor air economizer control	Where economizer: Differential dry-bulb temperature in 6A, 5A, all B and C climate zones; lockout on fixed enthalpy 65.1 kJ/kg or fixed dry-bulb OAT > 24°C in 0A to 4A climate zones					
Occupied *outdoor air* source	Packaged unit, occupied damper, all *building* use types					
Energy recovery ventilator *enthalpy recovery ratio* ; bypass; SAT set point, °C	No	No	No	No	~~No~~ Yes, in 0A, 1A, 2A, 3A, 50%, 15.6°C in 2A and 3A	~~No~~ Yes, all A, 6, 7, 8 50%, 15.6°C
Demand control ventilation	~~No~~ Yes	~~No~~ Yes	No	No	~~No~~ Yes	~~No~~ Yes
% Area variable control	15%	15%			80%	80%
% Area on/off control	65%	65%			0%	0%
Cooling source	DX, multistage	DX, multistage	DX, single stage (heat pump)	DX, single stage	DX, ~~single~~ 2 stage (heat pump)	DX, ~~single~~ 2 stage
Cooling *COP* (net of fan)	~~3.40~~ 3.83	~~3.40~~ 3.83	~~3.00~~ 3.82	~~3.00~~ 3.82	~~3.40~~ 3.76	~~3.50~~ 3.76
Heating source	*Electric resistance*	Gas *boiler*	Heat pump	Furnace	Heat pump	Furnace
Heating *COP* (net of fan)/furnace or *boiler efficiency*	1.0	~~75~~ 81% E_t	~~3.40~~ 3.81	8~~0~~1% E_t	~~3.40~~ 3.54	~~80~~81% E_t
Heating-*pump* power, W·s/L	NA	254	NA	NA	NA	NA
Heating-coil HW temperature difference, °C	NA	~~10~~ 27.8	NA	NA	NA	NA

a. Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
c. V_{oz} is the zone minimum outdoor airflow rate as defined in ASHRAE Standard 62.1.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-2 TSPR Reference Building Design HVAC Simple Systems 1 (SI) *(Continued)*

Building Type Parameter	Medium Office (warm) [a]	Medium Office (cold) [b]	Small Office (warm) [a]	Small Office (cold) [b]	Retail (warm) [a]	Retail (cold) [b]
Design HWST, °C	NA	82	NA	NA	NA	NA
HWST *reset set point* vs. OAT, °C	NA	HWST/OAT: 82–65.6/–6.7–10	NA	NA	NA	NA
HW-loop pumping control	NA	2-way valves ride the pump curve	NA	NA	NA	NA

a. Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
c. V_{oz} is the zone minimum outdoor airflow rate as defined in ASHRAE Standard 62.1.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-3 TSPR Reference Building Design HVAC Simple Systems 2 (I-P)

Building Type Parameter	Hotel (warm) [a]	Hotel (cold) [b]	Multifamily (warm) [a]	Multifamily (cold) [b]
System type	*PTHP*	*PTAC* with hydronic boiler	~~PTHP~~ Split AC	~~PTAC~~ Split AC
Fan control	~~Constant volume~~ Cycling	~~Constant volume~~ Cycling	~~Constant volume~~ Cycling	~~Constant volume~~ Cycling
Main fan power, W/cfm	0.300	0.300	~~0.300~~ 0.246	~~0.300~~ 0.246
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	<40°F	NA	<40°F	NA
Outdoor air economizer	No	No	No	No
Occupied *outdoor air* source	~~Packaged unit, occupied damper~~ DOAS	~~Packaged unit, occupied damper~~ DOAS	~~Packaged unit, occupied damper~~ DOAS	~~Packaged unit, occupied damper~~ DOAS
Energy recovery ventilator *enthalpy recovery ratio* bypass; SAT set point	~~No~~ Yes 60%; 60°F except 0 and 1, no bypass	~~No~~ Yes except 3C 60%; 60°F	~~No~~ Yes 50%	~~No~~ Yes except 3C 50%
Demand control ventilation	~~No~~ Yes	~~No~~ Yes	No	
% Area variable control	70	70		
% Area on/off control	0%	0%		
Cooling source	DX, single stage (heat pump)	DX, single stage	DX, single stage (heat pump)	DX, single stage
Cooling *COP* (net of fan)	~~3.10~~ 3.83	~~3.20~~ 3.83	~~3.10~~ 3.823	~~3.20~~ 3.6504
Heating source	*PTHP*	2 hydronic *boilers*	*PTHP*	~~2 hydronic *boilers*~~ Furnace
Heating *COP* (net of fan)/furnace or *boiler efficiency*	~~3.10~~ 3.44	~~75%~~ 81% E_t	~~3.10~~ 3.86	~~75% E_t~~ 80 *AFUE*
Heating *pump* power, W/gpm	NA	~~19~~ 16.1	NA	19
Heating-coil HW temperature difference, °F	NA	50	NA	~~50~~ NA
Design HWST, °F	NA	180	NA	~~180~~ NA
HWST reset *set point* vs. OAT, °F	NA	HWST/OAT: 180–150/20–50	NA	~~HWST/OAT: 180–150/20–50~~ NA
HW-loop pumping control	NA	2-way valves and ride *pump* curve	NA	~~Two-way valves and ride *pump* Curve~~ NA

a. "Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
Informative Note: See Section 3.3 for a full list of terms used in this table.

Table L4.3.2-3 TSPR Reference Building Design HVAC Simple Systems 2 (SI)

Building Type Parameter	Hotel (warm) [a]	Hotel (cold) [b]	Multifamily (warm) [a]	Multifamily (cold) [b]
System type	*PTHP*	*PTAC* with hydronic boiler	~~PTHP~~ Split AC	~~PTAC~~ Split AC
Fan control	~~Constant volume~~ Cycling	~~Constant volume~~ Cycling	~~Constant volume~~ Cycling	~~Constant volume~~ Cycling
Main fan power, W·s/L	~~4.74~~ 0.636	~~4.74~~ 0.636	~~4.74~~ 0.521	~~4.74~~ 0.269
Heat/cool sizing factor	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	<4.4°C	NA	<4.4°C	NA
Outdoor air economizer	No	No	No	No
Occupied *outdoor air* source	~~Packaged unit, occupied damper~~ DOAS	~~Packaged unit, occupied damper~~ DOAS	~~Packaged unit, occupied damper~~ DOAS	~~Packaged unit, occupied damper~~ DOAS
Energy recovery ventilator *enthalpy recovery ratio* bypass; SAT set point	~~No~~ Yes 60%; 15.6°C except 0 and 1, no bypass	~~No~~ Yes except 3C 60%; 15.6°C	~~No~~ Yes 50%	~~No~~ Yes except 3C 50%
Demand control ventilation	~~No~~ Yes	~~No~~ Yes	No	
% Area variable control	70	70		
% Area on/off control	0%	0%		
Cooling source	DX, single stage (heat pump)	DX, single stage	DX, single stage (heat pump)	DX, single stage
Cooling *COP* (net of fan)	~~3.10~~ 3.83	~~3.20~~ 3.83	~~3.10~~ 3.823	~~3.20~~ 3.6504
Heating source	*PTHP*	2 hydronic *boilers*	*PTHP*	~~2 hydronic *boilers*~~ Furnace
Heating *COP* (net of fan)/furnace or *boiler efficiency*	~~3.10~~ 3.44	~~75%~~ 81% E_t	~~3.10~~ 3.86	~~75% E_t~~ 80 *AFUE*
Heating *pump* power, W·s/L	NA	~~300~~ 255	NA	19
Heating-coil HW temperature difference, °C	NA	27.8	NA	~~27.8~~ NA
Design HWST, °C	NA	82.2	NA	~~82.2~~ NA
HWST reset *set point* vs. OAT, °C	NA	HWST/OAT: 180–150/20–50	NA	~~HWST/OAT: 180–150/20–50~~ NA
HW-loop pumping control	NA	2-way valves and ride *pump* curve	NA	~~Two-way valves and ride *pump* Curve~~ NA

a. "Warm" refers to Climate Zones 0 through 2 and 3A.
b. "Cold" refers to Climate Zones 3B, 3C, and 4 through 8.
Informative Note: See Section 3.3 for a full list of terms used in this table.

L5. TSPR METRIC FOR SITE HVAC ENERGY INPUT

For purposes of calculating *TSPR* for the *proposed design* and the *TSPR target building design*, the calculated HVAC *energy* input of each *building* project *energy* source shall be converted to cost using the *energy* cost prices from Table L5-1.

Informative Notes:

1. The blended heating prices in Table L5-1 that are used for *fossil fuels* are not intended to represent actual average prices, but to represent a consistent blended price per 1000 Btu used. This will avoid requiring the *simulation program* to run the target *systems* with a *fossil fuels* type that matches the proposed *building*. The common price per *site fuel* Btu allows proposed *system efficiency* to be properly compared with the target *system*.
2. Informative Table~~s~~ L5-2~~ through L5-5~~ include<u>s</u> values for alternate *energy* input metrics that may be adopted by a jurisdiction. If so, the jurisdiction should replace the *TSPR energy* input of *energy* cost in Section L5 with the alternate metric and should include appropriate metric values from Informative Table L5-2 into Table L5-1. ~~The jurisdiction should replace the MPF values in Table 6.6.2.2 with one of the following:~~
   - ~~For carbon emissions, replace Table 6.6.2.2 MPF values with those in Informative Table L5-3. This table allows users to compare the quantity of carbon dioxide emissions generated by the *proposed design building* to the target *building*. For compliance purposes, it is intended for use in voluntary standards and in jurisdictions where the use of a carbon emissions metric is not preempted by U.S. federal law.~~
   - ~~For source *energy*, replace Table 6.6.2.2 MPF values with those in Informative Table L5-4.~~
   - ~~For *site energy*, replace Table 6.6.2.2 MPF values with those in Informative Table L5-5.~~

Delete informative Tables L5-3 through L5-5.

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.

ASHRAE · 180 Technology Parkway · Peachtree Corners, GA 30092 · www.ashrae.org

About ASHRAE

Founded in 1894, ASHRAE is a global professional society committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration, and their allied fields.

As an industry leader in research, standards writing, publishing, certification, and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

To stay current with this and other ASHRAE Standards and Guidelines, visit www.ashrae.org/standards, and connect on LinkedIn, Facebook, Twitter, and YouTube.

Visit the ASHRAE Bookstore

ASHRAE offers its Standards and Guidelines in print, as immediately downloadable PDFs, and via ASHRAE Digital Collections, which provides online access with automatic updates as well as historical versions of publications. Selected Standards and Guidelines are also offered in redline versions that indicate the changes made between the active Standard or Guideline and its previous edition. For more information, visit the Standards and Guidelines section of the ASHRAE Bookstore at www.ashrae.org/bookstore.

IMPORTANT NOTICES ABOUT THIS STANDARD

To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit www.ashrae.org/standards to download them free of charge.

Addenda, errata, and interpretations for ASHRAE Standards and Guidelines are no longer distributed with copies of the Standards and Guidelines. ASHRAE provides these addenda, errata, and interpretations only in electronic form to promote more sustainable use of resources.

4/25