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

Public Review Draft

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

First Public Review (November 2024)
(Draft Shows Proposed Changes to Current Standard)

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FOREWORD

The modification removes the mechanical performance factors (MPFs) from the Total System Performance Ration (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 SSPC 90.1 as documented in a PNNL technical report. www.energycodes.gov/sites/default/files/2023-02/TechDoc_901-TSPR_2021oct21.pdf.

$$MPF = TSPRr / TSPRt$$

Compliance with Section 6.6.2 required that:

$$TSPRp \geq TSPRr / \text{MPF}$$

Where
TSPRt = target TSPR
TSPRr = reference *TSPR*
TSPRp = 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:

$$TSPRp \geq TSPRr$$

Where the reference system now represents "good, standard, current practice" as described in the updated Appendix L in this proposal This addendum to the standard is impacts an approach 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 bp to 90.1-2022

3.3 Abbreviations and Acronyms

~~MPF mechanical performance factor~~

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.
   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*~~

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

~~**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.~~

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:

$$\mathrm{EC}_{H01\_adj} = \mathrm{EC}_{H01\_base} \times \frac{TSPR_{sav}}{0.05} \times \mathrm{Area}_{TSPR}$$

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

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

Where:

EC_{H01_adj} = energy credits achieved for improved mechanical system performance
EC_{H01_base} = H01 base energy credit from Section 11.5.3

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

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

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]

NORMATIVE APPENDIX L
MECHANICAL SYSTEM PERFORMANCE RATING METHOD

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

Building Type Parameter	**Large Office ~~(warm)~~ Climate Zones 0 to 2 and 3A**	**Large Office (cold) Climates Zones 3B, 3C, and 4 to 8**	**School (warm) Climate Zones 0 to 2 and 3A**	**School (cold) 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 (2.388)	~~1.165~~ 1.127 (2.388)	~~1.165~~ 1.127 (2.388)	~~1.165~~ 1.127 (2.388)
Main fan power (W/cfm) proposed <MERV13	~~1.066~~ 1.030 (2.182)	~~1.066~~ 1.030 (2.182)	~~1.066~~ 1.030 (2.182)	~~1.066~~ 1.030 (2.182)
Zonal fan power, W/cfm	0.35	NA	0.35	NA
Minimum zone airflow fraction	1.5 × Voz	1.5 × Voz	1.2 × Voz	1.2 × Voz
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 & C climate zones; Lockout on fixed enthalpy >28 Btu/lb () or fixed drybulb OAT > 75°F (24°C) in 0A to 4A climate zones			
Occupied outdoor air (= proposed)	Sum(Voz)/0.75	Sum(Voz)/0.75	Sum(Voz)/0.65	Sum(Voz)/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% Et	1.0	80% Et
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%

Pump (constant flow/variable flow)	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	G3.1.3.11	G3.1.3.11	G3.1.3.11	G3.1.3.11
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: 424–54/80–60 (See Normative Appendix G.)	CHWST/OAT: 424–54/80–60 (See Normative Appendix G.)	CHWST/OAT: 424–54/80–60 (See Normative Appendix G.)	CHWST/OAT: 424–54/80–60 (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~~	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: 1840–15120/20–50	~~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.
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

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 (1.343)	~~1.285~~ 0.634 (1.343)	~~0.916~~ 0.486 (1.03)	~~0.916~~ 0.486 (1.03)	~~0.899~~ 0.585 (1.245)	~~0.899~~ 0.585 (1.245)
Main fan power (W/cfm) proposed <MERV13	~~1.176~~ 0.528 (1.119)	~~1.176~~ 0.528 (1.119)	~~0.850~~ 0.423 (0.896)	~~0.850~~ 0.423 (0.896)	~~0.835~~ 0.522 (1.106)	~~0.835~~ 0.522 (1.106)
Zonal fan power (W/cfm)	0.35	NA	NA	NA	NA	NA
Minimum zone airflow fraction	~~30%~~ 1.5* Voz	~~30%~~ 1.5* Voz	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 & C climate zones; Lockout on fixed enthalpy >28 Btu/lb () or fixed drybulb OAT > 75°F (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	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
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	Two-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.
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 2

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~~ 0.127
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	Two-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 Tables L5-2 through L5-5 include 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