



**BSR/ASHRAE/IES Addendum ba
to ANSI/ASHRAE/IES Standard 90.1-2022**

Public Review Draft

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

**First Advisory Public Review (July 2024)
(Draft Shows Proposed Changes to Current Standard)**

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(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

This addendum focuses on *Water Source Heat Pump (WSHP)* efficiency and metric changes. The proposed addendum has been developed to update the referenced AHRI standard for *WSHPs*, to use a new *annualized cooling metric*, and to increase the minimum efficiency requirements in table 6.8.1-15 for water-to-air *Water Source Heat Pumps*. Only changes are being made to the water-to-air products as the revised AHRI 600 Standard only covers these products. Water-to-water *WSHPs* will be addressed later when a revised test and rating standard AHRI 660 is completed, and also for geothermal heat pumps for commercial and residential applications. Some of the capacity categories for the water-to-air have been adjusted, and a new category for coil-only replacement products has been added.

Because of the significant changes to the AHRI 600 Standard and the use of a new annualized metric (*IEER*) the addendum will be released as an advisory public review to allow for early comments on the proposed new *IEER* annualized metric and the proposed increased minimum efficiency levels while cost justification is being completed. Additional changes may be made for water-to-water heat pumps and residential geothermal and commercial water source heat pumps that are still being developed.

In recent years, DOE has promoted moving commercial *WSHPs* to an *IEER* metric. *IEER* is not a recognized metric by ISO, so AHRI began the development of a separate AHRI 600 *IEER* calculation methodology standard for *WSHP* as simply an *IEER* calculation methodology using the original ISO/AHRI/ANSI/ASHRAE 13256-1998 performance data. This draft AHRI 600 *WSHP IEER* calculation standard did go out for public review in the fourth quarter of 2022, but development was shortly thereafter halted.

After a review, the *WSHP* standards committee felt the recommended DOE changes diverged so significantly from ISO/AHRI/ANSI/ASHRAE 13256-1998 standard that it warranted the development of a new AHRI standard and recommended eventually abandoning ISO/AHRI/ANSI/ASHRAE 13256-1998 standard. Therefore, beginning in the first quarter of 2023, a new expanded AHRI 600 Performance Rating of Water/Brine to Air *Water Source Heat Pump* equipment was developed using AHRI 340/360 as a framework and included the *IEER* methodology from the original AHRI 600. The current version is complete with commercial metrics and includes *IEER* calculation requirements.

AHRI industry manufacturers and DOE developed the new test procedure jointly as part of joint development initiative. The effort was completed in 2023, and DOE has published the final rule as of November 2023. This rule can be viewed at the following link:

<https://www.regulations.gov/docket/EERE-2017-BT-TP-0029/unified-agenda>

AHRI has documented the requirements defined in the final rule along with additional information to support rating and certification programs in the new AHRI 600 standard that can be downloaded from the following link:

<https://www.ahrinet.org/system/files/2023-10/ANSI%20AHRI%20Standard%20600-2023%20I-P.pdf>

This addendum complements the new AHRI 600 water-to-air *IEER* metric by developing proposed minimum efficiency levels based on a crosswalk and providing an additional efficiency improvement of 10% for smaller space-constrained products and 20% for larger products.

In addition to the change to use the new *IEER* annualized metric, the AHRI 600 standard includes an increase in external rating static from the current ISO 13256 standard that requires ratings to be based on zero external static. The new AHRI 600 standard rating external static pressures are summarized in the following table:

Rated Cooling Capacity, kBtu/h	External Static Pressure, in H ₂ O
0 to 28.8	0.10
29.0 to 42.9	0.15
43.0 to 74.9	0.20
75.0 to 134	0.75
135 to 280	1.00
281 and greater	1.50

Other notable changes that impact the efficiency of the products include the following:

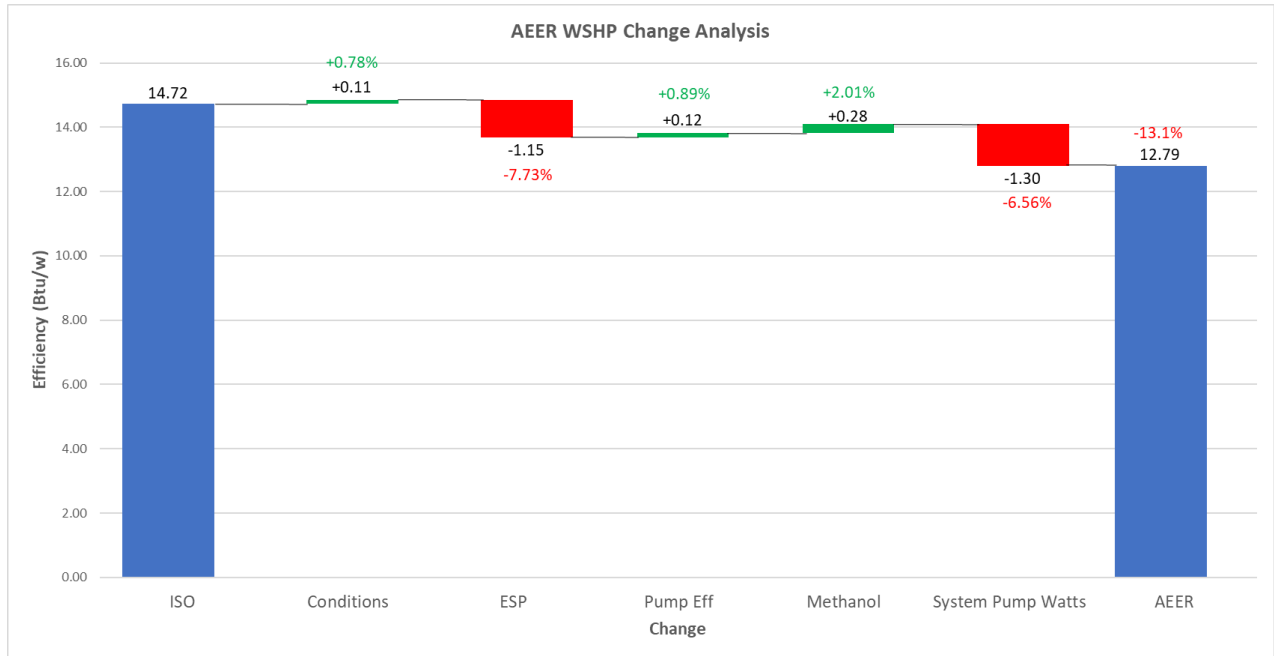
- Rating condition changes from hard metric rating conditions defined by ISO 13256.
- Change in condenser pump efficiency
- Adjustment for testing with methanol to remove the impact for ratings with water.
- Addition of cooling tower fan power and tower loop pump power.

Because of all the changes, the full load metric name for cooling is being changed from *EER* to *AEER* (applied *EER*), and the full load *COP* is being changed to *ACOP_H* (applied heating *COP_H*)

The technical support document cited provides details on the development of the new metric, the crosswalk, and efficiency improvements.

[Link to technical support presentation.](#)

The following chart is a crosswalk waterfall chart showing the impact of all the test and rating procedure changes for a nominal 3-ton unit full load *EER*.



AHRI has developed average cost increases for the proposed efficiency improvements which are summarized in the following table and in the technical support document.

Packaged Horiz and Vertical WSHP		Efficiency					Product Cost Increase	Notes:
Model Size	Configuration Category	Crosswalk IEER Level	Increase over Baseline	Minimum IEER Level	Minimum AEER	Minimum ACOP		
<20000	Size Constrained PSC	13.1	-	-	10.6	3.3	100%	Base
	Size Constrained ECM		10%	14.4			108%	MAX Tech Space
	Hi Effic PSC		7%	14.0			123%	Cost Tier
	Hi Effic ECM		18%	15.5			131%	MAX Tech
>20000<75000	Size Constrained PSC	14.2	-	-	11.7	3.5	100%	Base
	Size Constrained ECM		10%	15.6			107%	Cost Tier
	Size Constrained Dual Cap ECM		20%	17.0			117%	MAX Tech Space - Allowed Due to Same Size Compressor
	Hi Effic PSC		12%	15.9			120%	Cost Tier
	Hi Effic ECM		22%	17.3			127%	Cost Tier
	Dual Cap Hi Effic ECM		35%	19.2			137%	Cost Tier
	VS Hi Effic ECM							

Modeling is in process that will use the reference medium office building to determine the scalar, but is not yet completed. The final cost analysis will be included in the final full public review, pending any changes from the advisory public review.

For the advisory public review, we are seeking comments regarding the modified table and the proposed minimum efficiency levels for the following items for the air-to-water WSHPs. Other *WSHP* efficiencies have not changes at this time.

- Cooling full load *AEER* minimum efficiencies
- Cooling annualized *IEER* minimum efficiencies
- Full load HP heating *ACOP_H* minimum efficiencies

Please provide specific feedback, and if proposed changes are suggested, provide technical details and justification.

[Note to Reviewers: This public review draft makes proposed independent substantive changes to the previous public review draft. These changes are indicated in the text by underlining (for additions) and ~~striketrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the previous draft 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 substantive changes.]

Addendum ba to 90.1-2019

Add the following definitions to section 3 (I-P):

applied heating coefficient of performance ($ACOP_H$): A ratio of the heating capacity in watts to the power input values in watts at standard rating conditions H2, including system pump and cooling tower power, expressed in watts/watt

applied energy efficiency ratio (AEER): A ratio of the full-load cooling capacity in Btu/h to the power input values in watts at standard rating conditions C3, including system pump and cooling tower power, expressed in Btu/(W·h)

Water Source Heat Pump (WSHP) - A heat pump that consists of one or more factory-made assemblies with an indoor conditioning coil with air-moving means (except that coil-only indoor units do not have air-moving means), compressor(s), and refrigerant-to-water or refrigerant-to-brine heat exchanger(s), including means to provide both cooling and heating, cooling-only, or heating-only functions.

Add the following definitions to section 3 (SI):

applied heating coefficient of performance ($ACOP_H$): A ratio of the heating capacity in watts to the power input values in watts at standard rating conditions H2, including system pump and cooling tower power, expressed in watts/watt

applied cooling coefficient of performance ($ACOP_C$): A ratio of the cooling capacity in watts to the power input values in watts at standard rating conditions C3, including system pump and cooling tower power, expressed in watts/watt

Water Source Heat Pump (WSHP) - A heat pump that consists of one or more factory-made assemblies with an indoor conditioning coil with air-moving means (except that coil-only indoor units do not have air-moving means), compressor(s), and refrigerant-to-water or refrigerant-to-brine heat exchanger(s), including means to provide both cooling and heating, cooling-only, or heating-only functions.

Add the following abbreviations and acronyms to section 3.3 (I-P):

<u>$ACOP_H$</u>	<u>applied heating coefficient of performance</u>
<u>AEER</u>	<u>applied energy efficiency ratio</u>
<u>WSHP</u>	<u>water source heat pump</u>

Add the following abbreviations and acronyms to section 3.3 (SI):

<u>$ACOP_H$</u>	<u>applied heating coefficient of performance</u>
<u>$ACOP_C$</u>	<u>applied cooling coefficient of performance</u>
<u>WSHP</u>	<u>water source heat pump</u>

Modify Table 6.8.1-15 as follows (I-P):

Table 6.8.1-15 Electrically Operated Water Source Heat Pumps – Minimum Efficiency Requirements^b

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure ^a	
Water to air, water loop (cooling mode)	< 17,000 Btu/h	All	86°F enter water	12.2 <i>EER</i>	ISO 13256-1 Before 1/1/2029	
	≥17,000 Btu/h and <65,000 Btu/h			13.0 <i>EER</i>		
	≥65,000 Btu/h and <135,000 Btu/h			13.0 <i>EER</i>		
Water to air, water loop (cooling mode)	< 20,000 Btu/h	All	Split system and single package	10.6 <i>AEER</i>	AHRI 600 on or after 1/1/2029	
	>20,000 Btu/h and <75,000 Btu/h			14.4 <i>IEER</i>		
	11.7 <i>AEER</i>			17.0 <i>IEER</i>		
	>75,000 Btu/h and <135,000 Btu/h			11.0 <i>AEER</i>		14.9 <i>IEER</i>
	>135,000 Btu/h and <280,000 Btu/h			10.9 <i>AEER</i>		14.6 <i>IEER</i>
>280,000 Btu/h	10.3 <i>AEER</i>	13.8 <i>IEER</i>				
Water-to-air, water loop (cooling mode) Coil-Only Replacement^b	<37,000 Btu/h		Single Package	10.6 <i>AEER</i> 14.4 <i>IEER</i>	AHRI 600 on or after 1/1/2029	
Water-to-air, groundwater (cooling mode)	<135,000 Btu/h	All	59°F enter water	18.0 <i>EER</i>	ISO 13256-1	
Brine-to-air, ground loop (cooling mode)	<135,000 Btu/h	All	77°F enter water	14.1 <i>EER</i>	ISO 13256-1	
Water-to-air, groundwater (cooling mode)	<135,000 Btu/h	All	59°F enter water	18.0 <i>EER</i>	ISO 13256-1	
Brine-to-air, ground loop (cooling mode)	<135,000 Btu/h	All	77°F enter water	14.1 <i>EER</i>	ISO 13256-1	
Water-to-water, water loop (cooling mode)	<135,000 Btu/h	All	86°F enter water	14.1 <i>EER</i>	ISO 13256-2	
Water-to-water, groundwater (cooling mode)	<135,000 Btu/h	All	59°F enter water	14.1 <i>EER</i>	ISO 13256-2	
Brine-to-water, ground loop (cooling mode)	<135,000 Btu/h	All	77°F enter water	12.1 <i>EER</i>	ISO 13256-2	
Water-to-air, water loop (heating mode)	<135,000 Btu/h (cooling capacity)		68°F enter water	4.3 <i>COP_H</i>	ISO 13256-1	
Water-to-air, water loop (heating mode)	< 20,000 Btu/h (cooling capacity)		Split system and single package	3.3 <i>ACOP_H</i>	AHRI 600 After 1/1/2029	
	>20,000 Btu/h and <75,000 Btu/h (cooling capacity)			3.5 <i>ACOP_H</i>		
	≥75,000 Btu/h and <135,000 Btu/h (cooling capacity)			3.3 <i>ACOP_H</i>		
	≥135,000 Btu/h and <280,000 Btu/h (cooling capacity)			3.2 <i>ACOP_H</i>		
	≥280,000 Btu/h (cooling capacity)			3.2 <i>ACOP_H</i>		
Water-to-air, water loop (heating mode) Coil Only Replacement^b	<37,000 Btu/h		Single Package	3.3 <i>ACOP_H</i>	AHRI 600 After 1/1/2029	
Water-to-air, groundwater (heating mode)	<135,000 Btu/h (cooling capacity)		50°F enter water	3.7 <i>COP_H</i>	ISO 13256-1 Before 1/1/2029	

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Brine-to-air, ground loop (heating mode)	<135,000 Btu/h (cooling capacity)		32°F enter water	3.2 COP_H	ISO 13256-1
Water-to-water, water loop (heating mode)	<135,000 Btu/h (cooling capacity)		68°F enter water	3.7 COP_H	ISO 13256-2
Water-to-water, groundwater (heating mode)	<135,000 Btu/h (cooling capacity)		50°F enter water	3.1 COP_H	ISO 13256-2
Brine-to-water, ground loop (heating mode)	<135,000 Btu/h (cooling capacity)		32°F enter water	2.5 COP_H	ISO 13256-2

a. Section 13 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

b. ~~Single-phase, U.S. air-cooled heat pumps <65,000 Btu/h are regulated as consumer products by 10 CFR 430. SEER, SEER2, HPSF and HPSF2 values for single-phase products are set by the U.S. DOE.~~

b. Coil-only replacement efficiencies apply only to units installed in existing cabinet applications.

Informative Note: See Informative Appendix F for the U.S. DOE minimum.

Modify Table 6.8.1-15 as follows (SI):

Table 6.8.1-15 Electrically Operated Water Source Heat Pumps – Minimum Efficiency Requirements^b

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure ^a
Water to air, water loop (cooling mode)	< 5 kW	All	30°C enter water	3.58 COP _C	ISO 13256-1
	≥5 kW and <19 kW			3.81 COP _C	
	≥65,000 kW and <40 kW			3.81 COP _C	
Water to air, water loop (cooling mode)	< 6 kW	All	Split system and single package	3.11 ACOP _C	AHRI 600 on or after 1/1/2029
	≥6 kW and <22 kW			4.22 ICOP _C	
	≥22 kW and <40 kW			3.43 ACOP _C	
	≥40 kW and <82 kW			4.98 ICOP _C	
	≥82 kW			3.22 ACOP _C	
Water-to-air, water loop (heating mode) Coil-Only Replacement^b	≤ 6 kW	All	Single Package	4.37 ICOP _C	AHRI 600 On or after 1/1/2029
				3.19 ACOP _C	
Water-to-air, groundwater (cooling mode)	<40 kW	All	15°C enter water	5.28 COP _C	ISO 13256-1
Brine-to-air, ground loop (cooling mode)	<40 kW	All	25°C enter water	4.13 COP _C	ISO 13256-1
Water-to-air, groundwater (cooling mode)	<40 kW	All	15°C enter water	5.28 COP _C	ISO 13256-1
Brine-to-air, ground loop (cooling mode)	<40 kW	All	25°C enter water	4.13 COP _C	ISO 13256-1
Water-to-water, water loop (cooling mode)	<40 kW	All	30°C enter water	4.13 COP _C	ISO 13256-1
Water-to-water, groundwater (cooling mode)	<40 kW	All	15°C enter water	4.13 COP _C	ISO 13256-2
Brine-to-water, ground loop (cooling mode)	<40 kW	All	25°C enter water	3.55 COP _C	ISO 13256-2
Water-to-air, water loop (heating mode)	<40 kW (cooling capacity)		20°C enter water	4.3 COP _H	ISO 13256-1
Water to air, water loop (heating mode)	< 6 kW (Cooling capacity)		Split system and single package	3.3 ACOP _H	AHRI 600 After 1/1/2029
	≥6 kW and <22 kW (Cooling capacity)			3.5 ACOP _H	
	≥22 kW and <40 kW (Cooling capacity)			3.3 ACOP _H	
	≥40 kW and <82 kW (Cooling capacity)			3.2 ACOP _H	
	≥82 kW (Cooling capacity)			3.2 ACOP _H	
Water-to-air, water loop (heating mode) Coil Only Replacement^b	≤11 kW		Single Package	3.3 ACOP _H	AHRI 600 After 1/1/2029
Water-to-air, groundwater (heating mode)	<40 kW (cooling capacity)		10°C enter water	3.7 COP _H	ISO 13256-1

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Brine-to-air, ground loop (heating mode)	<40 kW (cooling capacity)		0°C enter water	3.2 COP _H	ISO 13256-1
Water-to-water, water loop (heating mode)	<40 kW (cooling capacity)		20°C enter water	3.7 COP _H	ISO 13256-2
Water-to-water, groundwater (heating mode)	<40 kW (cooling capacity)		10°C enter water	3.1 COP _H	ISO 13256-2
Brine-to-water, ground loop (heating mode)	<40 kW (cooling capacity)		0°C enter water	2.5 COP _H	ISO 13256-2

a. Section 13 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

~~b. Single-phase, U.S. air-cooled heat pumps <65,000 Btu/h are regulated as consumer products by 10 CFR 430. SEER, SEER2, HPSF and HPSF2 values for single-phase products are set by the U.S. DOE. The minimum efficiency requirements listed in this table apply to commercial single and three-phase products~~

~~b. Coil-only replacement efficiencies apply only to units installed in existing cabinet applications.~~

~~**Informative Note:** See Informative Appendix F for the U.S. DOE minimum.~~