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

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ASHRAE, 180 Technology Parkway NW, Peachtree Corners, GA 30092

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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 *WSHP*'s, 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 *WSHP*'s 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.

In the last few years, DOE has promoted moving commercial *WSHP*'s 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 development of a new AHRI standard and recommended eventually abandoning ISO/AHRI/ANSI/ASHRAE 13256-1998 standard. Therefore, beginning in first quarter 2023 a new expanded AHRI 600 Performance Rating of Water/Brine to Air *Waster 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.

The new test procedure was developed jointly by AHRI industry manufacturers and DOE 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 with the development of proposed minimum efficiency levels based on a cross walk and with 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 statics are summarized in the following table:

New AHRI 600 External Rating Static Pressure

Rated Cooling Capacity, kBtu/h	External Static Pressure, in H_2O
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

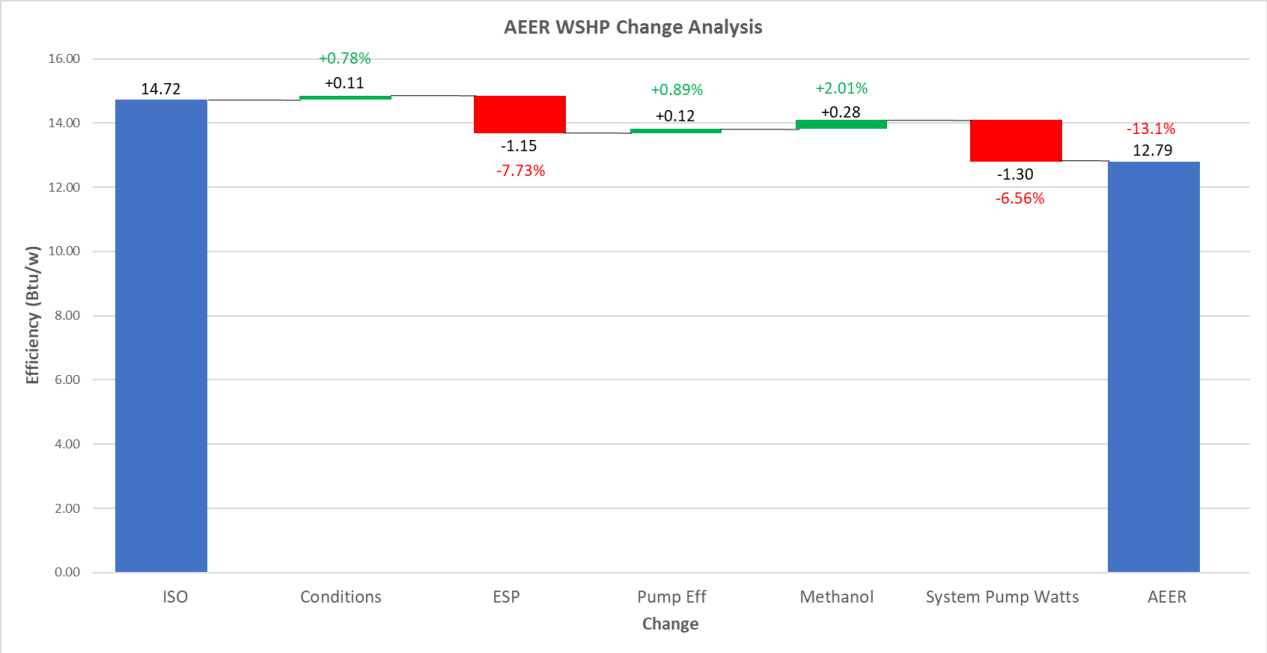
Other notable changes that impact the efficiency of the products include the following:

- 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)

Details on the development of the new metric and the cross walk and efficiency improvements are available in the referenced technical support document.

In the following chart is a cross walk water fall chart showing the impact of all the test and rating procedure changes for a nominal 3-ton unit full load *EER*.



AHRI has provided average cost increases for the improvement efficienies reflected in the metrics. Modeling was conducted by the ASHRAE 90.1 committee using the medium office reference building using a typical WSHP water loop cooling and heating system. The following weighted average scalar ratios were determined using an economizer life of 15 years which results in a Scalar Limit of 11.5 for heating and 11.4 for cooling

The following are the scalar ratios for the efficiency improvement and product cost increases.

Capacity Range	Energy cost only	Energy Cost + Social Cost of Carbon
	0.1122 $/kW Rate	0.1772 $/kW
<20,000 Btu/h	2.90	1.83
20,000 to 75,000 Btu/h	5.64	3.57

On average the scalar ratios without the cost of carbon and with the cost of carbon are below the scalar limit on a weighted average so the proposed efficiencies are cost justified.

[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 ~~strikethrough~~ (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.]

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For comments please use the following guidelines:
Submit comments into the system using the system data fields form comments along with substantiating statements

- *Limit comments to one topic and if you have multiple comments submit separate comments*
- *Try to be specific on changes that you think need to be made'*
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Addendum ba to 90.1-2022

Add the following definitions to Section 3 to the I-P standard

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 in AHRI Standard 600, 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 in AHRI Standard 600, 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 or water-to-water 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 to the SI standard

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 in AHRI Standard 600, including system pump and cooling tower power, expressed in watts/watt

applied cooling coefficient of performance (AEER): A ratio of the cooling capacity in watts to the power input values in watts at standard rating conditions C3 in AHRI Standard 600, 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 or water-to-water 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 for the I-P standard

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

Add the following abbreviations and acronyms to Section 3.3 for the SI standard

$ACOP_H$	applied heating coefficient of performance
AEER	applied cooling coefficient of performance
WSHP	water source heat pump

In the IP standard make the following additions to Table 6.8.1-15.

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 entering water	12.2 *EER*	ISO 13256-1 Before 1/1/2029
	≥17,000 Btu/h and <65,000 Btu/h			13.0 *EER*	
	≥65,000 Btu/h and <135,000 Btu/h			13.0 *EER*	
Water to air, water loop (cooling mode)	< 20,000 Btu/h	All	Split *system* and single package	10.6 *AEER* 14.4 *IEER*	AHRI 600 after 1/1/2029
	≥20,000 Btu/h and <75,000 Btu/h			11.7 *AEER* 17.0 *IEER*	
	≥75,000 Btu/h and <135,000 Btu/h			11.0 *AEER* 14.9 *IEER*	
	≥135,000 Btu/h and <280,000 Btu/h			10.9 *AEER* 14.6 *IEER*	
	≥280,000 Btu/h			10.3 *AEER* 13.8 *IEER*	
Water-to-air, water loop (cooling mode) Coil Only Replacement[b]	≤37,000 Btu/h		Single Package	10.6 *AEER* 14.4 *IEER*	AHRI 600 after 1/1/2029
~~Water-to-air, groundwater (cooling mode)~~	~~<135,000 Btu/h~~	~~All~~	~~59°F enter water~~	~~18.0 *EER*~~	~~ISO 13256-1~~
Brine-to-air, ground loop (cooling mode)	<135,000 Btu/h	All	77°F enter water	14.1 *EER*	ISO 13256-1 Before 1/1/2029
Water-to-air, groundwater (cooling mode)	<135,000 Btu/h	All	59°F enter water	18.0 *EER*	ISO 13256-1 Before 1/1/2029
~~Brine-to-air, ground loop (cooling mode)~~	~~<135,000 Btu/h~~	~~All~~	~~77°F enter water~~	~~14.1 *EER*~~	~~ISO 13256-1~~
Water-to-water, water loop (cooling mode)	<135,000 Btu/h	All	86°F enter water	14.1 *EER*	ISO 13256-2
Water-to-water, groundwater (cooling mode)	<135,000 Btu/h	All	59°F enter water	14.1 *EER*	ISO 13256-2
Brine-to-water, ground loop (cooling mode)	<135,000 Btu/h	All	77°F enter water	12.1 *EER*	ISO 13256-2
Water-to-air, water loop (heating mode)	<135,000 Btu/h (cooling capacity)		68°F enter water	4.3 COP_H	ISO 13256-1 Before 1/1/2029
Water-to-air, water loop (heating mode)	< 20,000 Btu/h (cooling capacity)		Split *system* and single package	3.3 $ACOP_H$	AHRI 600 After 1/1/2029
	≥20,000 Btu/h and <75,000 Btu/h (cooling capacity)			3.5 $ACOP_H$	
	≥75,000 Btu/h and ≤135,000 Btu/h (cooling capacity)			3.3 $ACOP_H$	
	≥135,000 Btu/h and ≤280,000 Btu/h (cooling capacity)			3.2 $ACOP_H$	
	≥280,000 Btu/h (cooling capacity)			3.2 $ACOP_H$	
Water-to-air, water loop (heating mode) Coil Only Replacement[b]	≤37,000 Btu/h		Single Package	3.3 $ACOP_H$	AHRI 600 After 1/1/2029

Water-to-air, groundwater (heating mode)	<135,000 Btu/h (cooling capacity)		50°F enter water	3.7 COP_H	ISO 13256-1 Before 1/1/2029
Brine-to-air, ground loop (heating mode)	<135,000 Btu/h (cooling capacity)		32°F enter water	3.2 COP_H	ISO 13256-1 Before 1/1/2029
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 being installed in existing cabinet applications.
~~***Informative Note:*** See Informative Appendix F for the U.S. DOE minimum~~.

In the SI standard make the following additions.

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 $ACOP_C$ 4.22 $ICOP_C$	AHRI 600 After 1/1/2029
	≥6 *kW* and <22 *kW*			3.43 $ACOP_C$ 4.98 $ICOP_C$	
	≥22 *kW* and <40 *kW*			3.22 $ACOP_C$ 4.37 $ICOP_C$	
	≥40 *kW* and <82 *kW*			3.19 $ACOP_C$ 4.28 $ICOP_C$	
	≥82 *kW*			3.02 $ACOP_C$ 4.04 $ICOP_C$	
Water-to-air, water loop (heating mode) Coil Only Replacement[b]	≤ 6 *kW*	All	Single Package	3.3 $ACOP_H$	AHRI 600 After 1/1/2029
~~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

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 being installed in existing cabinet applications.
~~***Informative Note:*** See Informative Appendix F for the U.S. DOE minimum.~~