BSR/ASHRAE/IES Addendum bd
to ANSI/ASHRAE/IES Standard 90.1-2016

First Public Review Draft

Proposed Addendum bd to Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings

First Public Review (November 2018)
(Draft Shows Proposed Changes to Current Standard)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

This standard is under continuous maintenance. To propose a change to the current standard, use the change submittal form available on the ASHRAE website, www.ashrae.org.

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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

Several years ago AHRI added testing and rating requirements for air and water cooled heat pump chillers packages and heat reclaim chillers to the AHRI 550/590 IP standard and to the AHRI 551/591 SI standard. This was done because this is a growing global product segment. The new AHRI requirements include multiple rating conditions for heating only chillers in both air and water cooled and combined heating and cooling for water cooled chillers. The new metrics are;

- The Heating Coefficient of Performance (COPH), kW/kW, shall be calculated as follows:

  $\mathrm{COP_H} = \frac{\mathrm{Q_{cd}}}{\mathrm{K3 \cdot W_{input}}}$ (note K3 is a conversion constant = 3412)

- *The Heat Recovery Coefficient of Performance (COPHR), kW/kW shall be calculated as follows:*

  $\mathrm{COP_{HR}} = \frac{\mathrm{Q_{ev} + Q_{hrc}}}{\mathrm{K3 \cdot W_{input}}}$ ((note K3 is a conversion constant = 3412)

- *The Simultaneous Heating and Cooling Coefficient of Performance (COPSHC), kW/kW, shall be calculated as follows:*

  $\mathrm{COP_{SHC}} = \frac{\mathrm{Q_{ev} + Q_{hrc}}}{\mathrm{K3 \cdot W_{input}}}$ (note K3 is a conversion constant = 3412)

Currently AHRI has an optional certification program for water to water heat pumps but has not yet established certification programs for air to water heat pump chillers and heat reclaim chillers.

In order to support industry requests to add requirements for heating chiller packages, the ASHRAE 90.1 committee release an advisory public review addendum BD to obtain feedback on proposed requirements and minimum efficiencies. No changes were proposed for the efficiency requirements but there were some editorial and formatting changes which have been included in this addendum draft. It was also suggest that we include the actual cooling efficiencies which we have done. The requirements for the cooling performance have been set equal to the cooling only chiller positive displacement requirements defined in table 6.8.1-3 less 5% to account for added refrigeration hardware like four way valves, accumulators, compressors and refrigerants changes that are optimized for heating lift and not just cooling operation. Keep in mind on an overall system basis heat reclaim and heat pump chiller provide both cooling and heating and are significant more efficient than cooling only systems with separate heating systems.

As these efficiencies align with currently produced chillers a cost effective analysis was not done as the minimum efficiencies proposed would not require added cost for improved efficiency. Once the efficiency levels are adopted and are used additional improvements will be considered in future addendum updates.

[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 BD to 90.1-2016

Add a new table 6.8.1-18 for heating chiller performance for IP standard.

As this expands the number of chapter 6 efficiency tables, the following text in section 6.4.1.1 will have to be revised.

6.4.1 Equipment Efficiencies, Verification, and Labeling Requirements

6.4.1.1 Minimum Equipment Efficiencies—Listed Equipment—Standard Rating and Operating Conditions

Equipment shown in Tables 6.8.1-1 through 6.8.1-~~16~~18 shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Where multiple rating conditions or performance requirements are provided, the *equipment* shall satisfy all stated requirements unless otherwise exempted by footnotes in the table. *Equipment* covered under the Federal *Energy* Policy Act of 1992 (EPACT) shall have no minimum *efficiency* requirements for operation at minimum capacity or other than standard rating conditions. *Equipment* used to provide *service water-heating* functions as part of a combination *system* shall satisfy all stated requirements for the appropriate *space* heating or cooling category.

Tables are as follows:

a. Table 6.8.1-1, "Electrically Operated Unitary Air Conditioners and *Condensing Units*—Minimum *Efficiency* Requirements"
b. Table 6.8.1-2, "Electrically Operated Unitary and Applied Heat Pumps—Minimum *Efficiency* Requirements"
c. Table 6.8.1-3, "Water-Chilling Packages—*Efficiency* Requirements" (See Section 6.4.1.2 for water-cooled centrifugal water-chilling packages that are designed to operate at nonstandard conditions.)
d. Table 6.8.1-4, "Electrically Operated *Packaged Terminal Air Conditioners*, *Packaged Terminal Heat Pumps*, *Single-Package Vertical Air Conditioners*, *Single-Package Vertical Heat Pumps*, *Room Air Conditioners*, and *Room Air Conditioner* Heat Pumps—Minimum *Efficiency* Requirements"
e. Table 6.8.1-5, "Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters—Minimum *Efficiency* Requirements"
f. Table 6.8.1-6, "Gas- and Oil-Fired *Boilers*—Minimum *Efficiency* Requirements"
g. Table 6.8.1-7, "Performance Requirements for Heat-Rejection *Equipment*"
h. Table 6.8.1-8, "Heat Transfer *Equipment*"
i. Table 6.8.1-9, "Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum *Efficiency* Requirements"
j. Table 6.8.1-10, "Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps—Minimum *Efficiency* Requirements

k. Table 6.8.1-11, "Air Conditioners and *Condensing Units* Serving *Computer Rooms*"
l. Table 6.8.1-12, "Commercial Refrigerators and Freezers—Minimum *Efficiency* Requirements"
m. Table 6.8.1-13, "Commercial Refrigeration—Minimum *Efficiency* Requirements"
n. Table 6.8.1-14, "Vapor-Compression-Based *Indoor Pool Dehumidifiers*—Minimum *Efficiency* Requirements"
o. Table 6.8.1-15, "Electrically Operated *DX-DOAS Units*, Single-Package and Remote Condenser, without *Energy* Recovery—Minimum *Efficiency* Requirements"
p. Table 6.8.1-16, "Electrically Operated *DX-DOAS Units*, Single-Package and Remote Condenser, with *Energy* Recovery—Minimum *Efficiency* Requirements"
r. Table 6.8.1-18, Heat Pump and Heat Reclaim Chiller Packages – Minimum Efficiency Requirement

Add the following new IP table for heat pump, heat reclaim and heat pump chillers

Table 6.8.1-18 Heat Pump and Heat Reclaim Chiller Packages – Minimum Efficiency Requirements

Equipment Type	Size Category (tons)	Cooling only Performance[a] (Air Cooled FL/IPLV-Btu/W) Water Source FL/IPLV-(kW/ton)		Heating Operation									Test Procedure
				Heating Source Conditions (F) (Entering/ leaving water) or OAT (db/wb)	Heat Pump Heating Full Load Efficiency (COP_H)[a] (W/W)[1]				Heat Reclaim Chiller Full Load Efficiency Full Load Efficiency (COP_{HR})[b,c] (W/W) Simultaneous Cooling and Heating Full Load Efficiency (COP_{SHC})[b] (W/W)				
					Leaving Heating Water Temperature				Leaving Heating Water Temperature				
					Low	Medium	High	Boost	Low	Medium	High	Boost	
		Path A	Path B		105 °F	120 °F	140 °F	140 °F	105 °F	120 °F	140 °F	140 °F	
Air Source	All sizes	≥9.595 FL ≥13.02 IPLV.IP	-≥9.215 FL ≥15.01 IPLV.IP	47 db 43 wb[d]	≥3.290	≥2.770	≥2.310	NA	NA	NA	NA	NA	AHRI 550/590
		≥9.595 FL ≥13.30 IPLV.IP	≥9.215 FL ≥15.30 IPLV.IP	17 db 15 wb[d]	≥2.230	≥1.950	≥1.630	NA	NA	NA	NA	NA	
Water Source electrically operated positive displacement	< 75	≤0.7885 FL ≤0.6316 IPLV.IP	≤0.7875 FL ≤0.5145 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	AHRI 550/590
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥75 and <150	≤0..7579 FL ≤0.5895 IPLV.IP	≤0.7140 FL ≤0.4620 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥150 and <300	≤0.6947 FL ≤0.5684 IPLV.IP	≤0.7140 FL ≤0.4620 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥300 and <600	≤0.6421 FL ≤0.5474 IPLV.IP	≤0.6563 FL ≤0.4305 IPLV.IP	54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	6.850	
	≥600	≤0.5895 FL ≤0.5263 IPLV.IP	≤0.6143 FL ≤0.3990 IPLV.IP	54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	6.850	
Water source electrically operated centrifugal	< 75	≤0.6421 FL ≤0.5789 IPLV.IP	≤0.7316 FL ≤0.4632 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	AHRI 550/590
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥75 and <150	≤0.5895 FL ≤0.5474 IPLV.IP	≤0.6684 FL ≤0.4211 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥150 and <300	≤0.5895 FL ≤0.5263 IPLV.IP	≤0.6263 FL ≤0.4105 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
		≤0.5895 FL	≤0.6158 FL	54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	

	≥300 and <600	≤0.5263 IPLV.IP	≤0.4000 IPLV.IP	75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	6.850	
	≥600	≤0.5895 FL ≤0.5263 IPLV.IP	≤0.6158 FL ≤0.4000 IPLV.IP	54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	6.850	

a. Cooling only rating conditions are standard rating conditions defined in AHRI 550/590 table 1
b Heating Full Load Rating conditions are at rating conditions defined in AHRI 550/590 table 1
c For water cooled heat reclaim chillers that have capabilities for heat rejection to a heat reclaim condenser and a tower condenser the COP_{HR} applies to operation at full load with 100% heat reclaim (no tower rejection). Units that only have capabilities for partial heat reclaim shall meet the requirements of table 6.8.1-3
d Outdoor air entering dry bulb temperature
e Source water entering and leaving water temperature

Add a new table 6.8.1-12 for heating chiller performance for SI standard

Table 6.8.1-12 Heat Pump and Heat Reclaim Chiller Packages – Minimum Efficiency Requirements

Equipment Type	Size Category (kW)	Cooling only Performance[b] (Air Cooled FL/IPLV-W/W) Water Source FL/IPLV-(W/W)		Heating Operation									Test Procedure
				Heating Source Conditions (°C) (Entering/ leaving water) or OAT (db/wb)	Heat Pump Heating Full Load Efficiency (COP_H)[a] (W/W)				Heat Reclaim Chiller Full Load Efficiency Full Load Efficiency (COP_{HR})[b,c] (W/W) Simultaneous Cooling and Heating Full Load Efficiency (COP_{SHC})[b] (W/W)				
					Leaving Heating Water Temperature				Leaving Heating Water Temperature				
					Low	Medium	High	Boost	Low	Medium	High	Boost	
		Path A	Path B		40 °C	50 °C	60 °C	60 °C	40 °C	50 °C	60 °C	60 °C	
Air Source	All sizes	≥2.836 FL ≥3.846 IPLV.SI	-≥2.723 FL ≥4.436 IPLV.SI	8.0 db[d] 6.0 wb	≥3.250	≥2.720	≥3.330	NA	NA	NA	NA	NA	AHRI 551/591
		≥2.836 FL ≥3.930 IPLV.SI	≥2.723 FL ≥4.520 IPLV.SI	-8.0 db[d] -9.0 wb	≥2.250	≥1.920	≥1.640	NA	NA	NA	NA	NA	
Water Source electrically operated positive displacement	< 264	≥4.659 FL ≥5.574 IPLV.SI	≥4.287 FL ≥6.689 IPLV.SI	12/7[e]	≥4.760	≥3.610	≥2.660	NA	≥8.550	≥6.290	≥4.390	NA	AHRI 551/591
				24/19[e]	NA	NA	NA	≥3.530	NA	NA	NA	≥6.100	
	≥264 and <528	≥4.645 FL ≥5.972 IPLV.SI	≥4.459 FL ≥6.825 IPLV.SI	12/7[e]	≥4.760	≥3.610	≥2.660	NA	≥8.550	≥6.290	≥4.390	NA	
				24/19[e]	NA	NA	NA	≥3.530	NA	NA	NA	≥6.100	
	≥528 and <1055	≥5.067 FL ≥6.193 IPLV.SI	≥4.918 FL ≥7.601 IPLV.SI	12/7[e]	≥4.760	≥3.610	≥2.660	NA	≥8.550	≥6.290	≥4.390	NA	
				24/19[e]	NA	NA	NA	≥3.530	NA	NA	NA	≥6.100	
	≥1055 and <2110	≥5.482 FL ≥6.432 IPLV.SI	≥5.351 FL ≥8.157 IPLV.SI	12/7[e]	≥5.060	≥3.880	≥2.950	NA	≥9.140	≥6.850	≥4.960	NA	
				24/19[e]	NA	NA	NA	≥3.870	NA	NA	NA	≥6.800	
	≥2110	≥5.072 FL ≥6.689 IPLV.SI	≥5.717 FL ≥8.801 IPLV.SI	12/7[e]	≥5.060	≥3.880	≥2.950	NA	≥9.140	≥6.850	≥4.960	NA	
				24/19[e]	NA	NA	NA	≥3.870	NA	NA	NA	≥6.800	
Water source electrically operated centrifugal	< 264	≥5.482 FL ≥6.081 IPLV.SI	≥4.812 FL ≥7.601 IPLV.SI	12/7[e]	≥4.760	≥3.610	≥2.660	NA	≥8.550	≥6.290	≥4.390	NA	AHRI 551/591
				24/19[e]	NA	NA	NA	≥3.530	NA	NA	NA	≥6.100	
	≥264 and <528	≥5.482 FL ≥6.081 IPLV.SI	≥5.267 FL ≥6.361 IPLV.SI	12/7[e]	≥4.760	≥3.610	≥2.660	NA	≥8.550	≥6.290	≥4.390	NA	
				24/19[e]	NA	NA	NA	≥3.530	NA	NA	NA	≥6.100	
	≥528 and <1055	≥5.972 FL ≥6.432 IPLV.SI	≥5.621 FL ≥8.567 IPLV.SI	12/7[e]	≥4.760	≥3.610	≥2.660	NA	≥8.550	≥6.290	≥4.390	NA	
				24/19[e]	NA	NA	NA	≥3.530	NA	NA	NA	≥6.100	
	≥1055 and <2110	≥5.972 FL ≥6.689 IPLV.SI	≥5.717 FL ≥8.801 IPLV.SI	12/7[e]	≥5.060	≥3.880	≥2.950	NA	≥9.140	≥6.850	≥4.960	NA	
				24/19[e]	NA	NA	NA	≥3.870	NA	NA	NA	≥6.800	

	≥2110	≥5.972 FL ≥6.689 IPLV.SI	≥5.717 FL ≥8.801 IPLV.SI	12/7[e]	≥5.060	≥3.880	≥2.950	NA	≥9.140	≥6.850	≥4.960	NA	
				24/19[e]	NA	NA	NA	≥3.870	NA	NA	NA	≥6.800	

a. Cooling only rating conditions are standard rating conditions defined in AHRI 551/591 table 1
b Heating Full Load Rating conditions are at rating conditions defined in AHRI 551/591 table 1
c For water cooled heat reclaim chillers that have capabilities for heat rejection to a heat reclaim condenser and a tower condenser the COP_{HR} applies to operation at full load with 100% heat reclaim. Units that only have capabilities for partial heat reclaim shall meet the requirements of table 6.8.1-3
d Outdoor air entering dry bulb temperature
e Source water entering and leaving water temperature

Note to Reviewer: Other addenda are modifying section 6.4.1 that are not yet published. The combined changes of this addendum and others will appear as follows (This information is provided for reference only and is not out for comment):

6.4.1 Equipment Efficiencies, Verification, and Labeling Requirements

6.4.1.1 Minimum Equipment Efficiencies—Listed Equipment—Standard Rating and Operating Conditions

Equipment shown in Tables 6.8.1-1 through 6.8.1-19 shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Where multiple rating conditions or performance requirements are provided, the *equipment* shall satisfy all stated requirements unless otherwise exempted by footnotes in the table. *Equipment* covered under the Federal *Energy* Policy Act of 1992 (EPACT) shall have no minimum *efficiency* requirements for operation at minimum capacity or other than standard rating conditions. *Equipment* used to provide *service water-heating* functions as part of a combination *system* shall satisfy all stated requirements for the appropriate *space* heating or cooling category.

Tables are as follows:

a. Table 6.8.1-1, “Electrically Operated Unitary Air Conditioners and *Condensing Units*—Minimum *Efficiency* Requirements”
b. Table 6.8.1-2, “Electrically Operated Air Cooled Unitary Heat Pumps—Minimum *Efficiency* Requirements”
c. Table 6.8.1-3, “Water-Chilling Packages—*Efficiency* Requirements” (See Section 6.4.1.2 for water-cooled centrifugal water-chilling packages that are designed to operate at nonstandard conditions.)
d. Table 6.8.1-4, “Electrically Operated *Packaged Terminal Air Conditioners*, *Packaged Terminal Heat Pumps*, *Single-Package Vertical Air Conditioners*, and *Single-Package Vertical Heat Pumps*, *Room Air Conditioners*, and *Room Air Conditioner* Heat Pumps—Minimum *Efficiency* Requirements”
e. Table 6.8.1-5, “Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters—Minimum *Efficiency* Requirements”
f. Table 6.8.1-6, “Gas- and Oil-Fired *Boilers*—Minimum *Efficiency* Requirements”
g. Table 6.8.1-7, “Performance Requirements for Heat-Rejection *Equipment*”
h. Table 6.8.1-8, “Heat Transfer *Equipment*”
i Table 6.8.1-9, “Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum *Efficiency* Requirements”
j Table 6.8.1-10, “Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps—Minimum Efficiency Requirements

k Table 6.8.1-11, "Floor Mounted Air Conditioners and *Condensing Units* Serving *Computer Rooms*"

l Table 6.8.1-13, "Commercial Refrigeration—Minimum *Efficiency* Requirements"

m Table 6.8.1-14, "Vapor-Compression-Based Indoor Pool Dehumidifiers—Minimum Efficiency Requirements"

n Table 6.8.1-15, "Electrically Operated *DX-DOAS Units*, Single-Package and Remote Condenser, without *Energy* Recovery—Minimum *Efficiency* Requirements"

o Table 6.8.1-16, "Electrically Operated *DX-DOAS Units*, Single-Package and Remote Condenser, with *Energy* Recovery—Minimum *Efficiency* Requirements"

p. Table 6.8.1-17, "Electrically Operated Water Source Heat Pumps—Minimum Efficiency Requirements"

q Table 6.8.1-18 "Heat Pump and Heat Reclaim Chiller Packages – Minimum Heating Efficiency Requirements"

r Table 6.8.1-19 Ceiling Mounted Computer Room Air Conditioners – Minimum Efficiency Requirements

Table 6.8.1-18 Heat Pump and Heat Reclaim Chiller Packages – Minimum Efficiency Requirements

Equipment Type	Size Category (tons)	Cooling only Performance[a] (Air Cooled FL/IPLV-Btu/W) Water Source FL/IPLV-(kW/ton)		Heating Operation								Test Procedure
				Heating Source Conditions (F) (Entering/ leaving water) or OAT (db/wb)	Heat Pump Heating Full Load Efficiency (COP_H)[a,] (W/W)[]				Heat Reclaim Chiller Full Load Efficiency Full Load Efficiency (COP_{HR})[b,c,] (W/W) Simultaneous Cooling and Heating Full Load Efficiency (COP_{SHC})[b,] (W/W)				
					Leaving Heating Water Temperature				Leaving Heating Water Temperature				
					Low	Medium	High	Boost	Low	Medium	High	Boost	
		Path A	Path B		105 °F	120 °F	140 °F	140 °F	105 °F	120 °F	140 °F	140 °F	
Air Source	All sizes	≥9.595 FL ≥13.02 IPLV.IP	-≥9.215 FL ≥15.01 IPLV.IP	47 db 43 wb[d]	≥3.290	≥2.770	≥2.310	NA	NA	NA	NA	NA	AHRI 550/590
		≥9.595 FL ≥13.30 IPLV.IP	≥9.215 FL ≥15.30 IPLV.IP	17 db 15 wb[d]	≥2.230	≥1.950	≥1.630	NA	NA	NA	NA	NA	
Water Source electrically operated positive displacement	< 75	≤0.7885 FL ≤0.6316 IPLV.IP	≤0.7875 FL ≤0.5145 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	AHRI 550/590
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥75 and <150	≤0..7579 FL ≤0.5895 IPLV.IP	≤0.7140 FL ≤0.4620 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥150 and <300	≤0.6947 FL ≤0.5684 IPLV.IP	≤0.7140 FL ≤0.4620 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥300 and <600	≤0.6421 FL ≤0.5474 IPLV.IP	≤0.6563 FL ≤0.4305 IPLV.IP	54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	6.850	
	≥600	≤0.5895 FL ≤0.5263 IPLV.IP	≤0.6143 FL ≤0.3990 IPLV.IP	54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	6.850	
Water source electrically operated centrifugal	< 75	≤0.6421 FL ≤0.5789 IPLV.IP	≤0.7316 FL ≤0.4632 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	AHRI 550/590
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥75 and <150	≤0.5895 FL ≤0.5474 IPLV.IP	≤0.6684 FL ≤0.4211 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥150 and <300	≤0.5895 FL ≤0.5263 IPLV.IP	≤0.6263 FL ≤0.4105 IPLV.IP	54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
				75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	6.150	
	≥300 and <600	≤0.5895 FL ≤0.5263 IPLV.IP	≤0.6158 FL ≤0.4000 IPLV.IP	54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	6.850	
	≥600	≤0.5895 FL ≤0.5263 IPLV.IP	≤0.6158 FL ≤0.4000 IPLV.IP	54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
				75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	6.850	

a. Cooling only rating conditions are standard rating conditions defined in AHRI 550/590 table 1
b Heating Full Load Rating conditions are at rating conditions defined in AHRI 550/590 table 1
c For water cooled heat reclaim chillers that have capabilities for heat rejection to a heat reclaim condenser and a tower condenser the COP_{HR} applies to operation at full load with 100% heat reclaim (no tower rejection). Units that only have capabilities for partial heat reclaim shall meet the requirements of table 6.8.1-3
d Outdoor air entering dry bulb temperature
e Source water entering and leaving water temperature