ANSI/ASHRAE/IES Addendum x to ANSI/ASHRAE/IES Standard 90.1-2019

Energy Standard for Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on December 9, 2021, and by the Illuminating Engineering Society on December 8, 2021.

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ISSN 1041-2336
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Addendum x updates three requirements for chillers:

a. Section 6.4.1.2.1 $K_{adj}$ cooling efficiency adjustment for centrifugal chillers.
b. Section 6.4.1.2.2 for chillers with a freeze-protection fluid
c. Addendum x standardizes use of the term “heat exchanger liquid” throughout the standard.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and strike-through (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Modify Section 3.2, “Definitions” as shown (I-P).

integrated part-load value (IPLV.I-P): a single-number figure of merit based on part-load EER, $COP_c$, or $kW/kW$ expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

nonstandard part-load value (NPLV.I-P): a single-number part-load efficiency figure of merit calculated and referenced to conditions other than IPLV.I-P conditions, for units that are not designed to operate at AHRI standard rating conditions.

Modify Section 3.3, “Definitions” as shown (I-P).

Modify Section 6.4.1.1(c) as shown (I-P and SI).

c. Table 6.8.1-3, “Water Liquid-Chilling Packages—Minimum Efficiency Requirements” (See Section 6.4.1.2 for water liquid-cooled centrifugal water liquid-chilling packages that are designed to operate at nonstandard conditions.)

Modify Section 6.4.1.2.1 as shown (I-P).

6.4.1.2 Minimum Equipment Efficiencies—Listed Equipment—Nonstandard Conditions

6.4.1.2.1 Water Liquid-Cooled Centrifugal Chilling Packages Cooling Efficiency Adjustment. Liquid-cooled centrifugal chiller packages Equipment not designed for cooling operation at AHRI Standard 550/590 test and rating conditions of 44.00°F leaving and 54.00°F entering chilled-fluid liquid temperatures, and with 85.00°F entering and 94.30°F leaving condenser-fluid liquid temperatures, shall have maximum full-load kW/ton (FL) and part-load cooling energy efficiency (IPLV.I-P) rating requirements, listed in Tables 6.8.1-3 and 6.8.1-16, adjusted using the following equations:

$$FL_{adj} = FL/\lambda_{adj}$$
$$IPLV_{adj} = IPLV/IP_{adj}$$

where

FL.I-P = full-load kW/ton value from Table 6.8.1-3 or 6.8.1-16
FL.I-P adj = maximum full-load kW/ton rating, adjusted for nonstandard conditions
**IPLV**<sub>IP</sub> = *IPLV*<sub>IP</sub> value from Table 6.8.1-3 or 6.8.1-16

PLV<sub>IP,adj</sub> = maximum NPLV<sub>IP</sub> rating, adjusted for nonstandard conditions

\[
A = \frac{0.00000014592 \times (\text{LIFT})^4 - 0.0000346496 \times (\text{LIFT})^3 + 0.00314196 \times (\text{LIFT})^2 - 0.147199 \times (\text{LIFT}) + 3.93073}{LvgCond - LvgEvap}
\]

\[
B = 0.0015 \times LvgEvap + 0.934
\]

\[
A = 0.00000014592 \times (49.16)^4 - 0.0000346496 \times (49.16)^3 + 0.00314196 \times (49.16)^2 - 0.147199 \times (49.16) + 3.93073 = 1.02331
\]

\[
B = 0.0015 \times 42.00 + 0.934 = 0.99700
\]

\[
K_{adj} = 1.02331 \times 0.99700 = 1.02024
\]

\[
FL_{adj} = \frac{0.5600}{1.02024} = 0.5489 \text{ kW/ton}
\]

\[
PLV_{adj} = \frac{0.5000}{1.02024} = 0.4901 \text{ kW/ton}
\]

Modified Section 6.4.1.2.2 as shown (I-P).

**6.4.1.2.2 Positive Displacement (Air- and Water-Cooled) Chilling Packages Chilling Packages Employing Freeze-Protection Liquids.** Equipment with an evaporator leaving fluid temperature higher than 32.00°F and water-cooled positive displacement chilling packages with a condenser leaving fluid temperature below 115.00°F shall show compliance with Table 6.8.1-3 when tested or certified with water at standard rating conditions, per the referenced test procedure. Electrically operated chilling packages that employ freeze-protection liquids in any heat exchanger with an application cooling duty evaporator liquid leaving temperature or heating operation source liquid temperature above 32.00°F shall show efficiency compliance in accordance with the applicable requirements in Sections 6.4.1.2.2.1 through 6.4.1.2.2.4.

Absorption chilling packages with freeze-protection liquids are exempt from the efficiency requirements listed in Table 6.8.1-3 and shall only show compliance when applied with water.

**6.4.1.2.2.1 All electrically operated cooling-only air-cooled and electrically operated positive displacement liquid-cooled chilling packages shall show compliance with the cooling efficiency requirements listed in Table 6.8.1-3 when applied within the operating limits of AHRI 550/590 at AHRI 550/590 standard rating conditions when tested or rated with water used as a heat transfer liquid.**
6.4.1.2.2 All liquid-cooled electrically operated cooling-only centrifugal chilling packages shall show compliance with the cooling efficiency requirements listed in Table 6.8.1-3 when applied within the operating limits defined in AHRI 550/590, at the application rating conditions for a cooling efficiency, adjusted using $K_{adj}$ as defined in Section 6.4.1.2.1, when tested or rated with water used as a heat transfer liquid.

6.4.1.2.3 All electrically operated air-source and electrically operated positive displacement liquid-source heat pump and heat recovery chilling packages shall show compliance with the cooling efficiency requirements listed in Table 6.8.1-16 when applied within the operating limits of AHRI 550/590 at AHRI 550/590 standard rating conditions when tested or rated with water used as a heat transfer liquid. They also shall show compliance with the heating efficiency requirements listed in Table 6.8.1-16 at one of the AHRI 550/590 standard heating rating conditions when tested or rated with water used as a heat-transfer liquid. Heating-only chilling packages shall meet the efficiency requirements at one of the AHRI 550/590 heating liquid temperature rating conditions and are not required to meet the cooling efficiency requirements of Table 6.8.1-16.

6.4.1.2.4 All liquid-source centrifugal heat pump and heat recovery chilling packages shall show compliance with the cooling efficiency requirements listed in Table 6.8.1-16 when applied within the operating limits defined in AHRI 550/590 at the application rating conditions for cooling efficiency, adjusted using $K_{adj}$ as defined in Section 6.4.1.2.1, when tested or rated with water. They also shall show compliance with the heating efficiency requirements in Table 6.8.1-16 at one of the AHRI 550/590 standard rating conditions when tested or rated with water used as a heat-transfer liquid. Heating-only chilling packages shall meet the heating efficiency requirements at one of the AHRI 550/590 heating liquid temperature rating conditions and are not required to meet the cooling efficiency requirements of Table 6.8.1-16.

Modify Table 6.8.1-3 to change “water” to “liquid” and correct some of the significant figures in the table to align with the requirements defined in AHRI 550/590 which requires 4 significant figures for efficiency metrics (I-P).

### Table 6.8.1-3 Water/Liquid-Chilling Packages—Minimum Efficiency Requirements a,b,e,f

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Size Category</th>
<th>Units</th>
<th>Path A</th>
<th>Path B</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-cooled chillers</td>
<td>&lt;150 tons</td>
<td>EER (Btu/Wh)</td>
<td>≥10.10 FL</td>
<td>≥9.70 FL</td>
<td>AHRI 550/590</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥13.700 IPLV/IP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥150 tons</td>
<td></td>
<td>≥10.10 FL</td>
<td>≥9.70 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥14.004 IPLV/IP</td>
<td>≥16.104 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td>Air-cooled without condenser, electrically operated</td>
<td>All capacities</td>
<td>EER (Btu/Wh)</td>
<td>Air-cooled chillers without condensers must be rated with matching condensers and comply with air-cooled chiller efficiency requirements</td>
<td></td>
<td>AHRI 550/590</td>
</tr>
</tbody>
</table>

a. The requirements for centrifugal chilling packages shall be adjusted for nonstandard rating conditions per Section 6.4.1.2.1 and are only applicable for the range of conditions listed there. The requirements for air-cooled, water liquid-cooled positive displacement and absorption chilling packages are at standard rating conditions defined in the reference test procedure.
b. Both the full-load and IPLV/IP requirements must be met or exceeded to comply with this standard. When there is a Path B, compliance can be with either Path A or Path B for any application.
c. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
d. NA means the requirements are not applicable for Path B, and only Path A can be used for compliance.
e. FL is the full-load performance requirements, and IPLV/IP is for the part-load performance requirements.
f. Electrically operated chilling packages employing a freeze-protection liquid in accordance with Section 6.4.1.2.2 shall be tested or rated with water for the purpose of compliance with the requirements of this table.
### Table 6.8.1-3 Water-Liquid-Chilling Packages—Minimum Efficiency Requirements a,b,e,f

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Size Category</th>
<th>Units</th>
<th>Path A</th>
<th>Path B</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-Liquid-cooled, electrically operated positive displacement</td>
<td>&lt;75 tons</td>
<td>kW/ton</td>
<td>≤0.7500 FL</td>
<td>≤0.7800 FL</td>
<td>AHRI 550/590</td>
</tr>
<tr>
<td></td>
<td>≥75 tons and &lt;150 tons</td>
<td></td>
<td>≤0.6000 IPLV/IP</td>
<td>≤0.5000 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥150 tons and &lt;300 tons</td>
<td></td>
<td>≤0.7200 FL</td>
<td>≤0.7590 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥300 tons and &lt;600 tons</td>
<td></td>
<td>≤0.5600 IPLV/IP</td>
<td>≤0.4900 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥600 tons</td>
<td></td>
<td>≤0.6600 FL</td>
<td>≤0.6800 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5400 IPLV/IP</td>
<td>≤0.4400 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.6100 FL</td>
<td>≤0.6250 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5200 IPLV/IP</td>
<td>≤0.4100 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5600 FL</td>
<td>≤0.5850 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5000 IPLV/IP</td>
<td>≤0.3800 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td>Water-Liquid-cooled, electrically operated centrifugal</td>
<td>&lt;150 tons</td>
<td>kW/ton</td>
<td>≤0.6100 FL</td>
<td>≤0.6950 FL</td>
<td>AHRI 550/590</td>
</tr>
<tr>
<td></td>
<td>≥150 tons and &lt;300 tons</td>
<td></td>
<td>≤0.5500 IPLV/IP</td>
<td>≤0.4400 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥300 tons and &lt;400 tons</td>
<td></td>
<td>≤0.6100 FL</td>
<td>≤0.6350 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥400 tons and &lt;600 tons</td>
<td></td>
<td>≤0.5500 IPLV/IP</td>
<td>≤0.4000 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥600 tons</td>
<td></td>
<td>≤0.6600 FL</td>
<td>≤0.6800 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5400 IPLV/IP</td>
<td>≤0.4400 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5600 FL</td>
<td>≤0.5950 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5200 IPLV/IP</td>
<td>≤0.3900 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5600 FL</td>
<td>≤0.5850 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤0.5000 IPLV/IP</td>
<td>≤0.3800 IPLV/IP</td>
<td></td>
</tr>
<tr>
<td>Air-cooled absorption, single effect</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>≥0.6000 FL</td>
<td>NA d</td>
<td>AHRI 560</td>
</tr>
<tr>
<td>Water-Liquid-cooled absorption, single effect</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>≥0.7000 FL</td>
<td>NA d</td>
<td>AHRI 560</td>
</tr>
<tr>
<td>Absorption double effect, indirect fired</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>≥1.000 FL</td>
<td>NA d</td>
<td>AHRI 560</td>
</tr>
<tr>
<td>Absorption double effect, direct fired</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>≥1.000 FL</td>
<td>NA d</td>
<td>AHRI 560</td>
</tr>
</tbody>
</table>

**Notes:**

- a. The requirements for centrifugal chillers, chilling packages shall be adjusted for nonstandard rating conditions per Section 6.4.1.2.1 and are only applicable for the range of conditions listed there. The requirements for air-cooled, Water-liquid-cooled positive displacement and absorption chillers, chilling packages are at standard rating conditions defined in the reference test procedure.
- b. Both the full-load and IPLV/IP requirements must be met or exceeded to comply with this standard. When there is a Path B, compliance can be with either Path A or Path B for any application.
- c. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- d. NA means the requirements are not applicable for Path B, and only Path A can be used for compliance.
- e. FL is the full-load performance requirements, and IPLV/IP is for the part-load performance requirements.
- f. Electrically operated chilling packages employing a freeze-protection liquid in accordance with Section 6.4.1.2.2 shall be tested or rated with water for the purpose of compliance with the requirements of this table.
Modify Section 3.2 as shown (SI).

**Integrated Part-Load Value (IPLV.SI):** A single-number figure of merit based on part-load COPC expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

[...]

**Nonstandard Part-Load Value (NPLV.SI):** A single-number part-load efficiency figure of merit calculated and referenced to conditions other than IPLV.SI conditions, for units that are not designed to operate at AHRI standard rating conditions.

[...]

Modify Section 3.3 as shown (SI).

IPLV.SI integrated part-load value

[...]

NPLV.SI nonstandard part-load value

Modify Section 6.4.1.2 as shown (SI).

### 6.4.1.2.1 Water Liquid-Cooled Centrifugal Chilling Packages Cooling Efficiency Adjustment.

Liquid-cooled centrifugal chiller packages not designed for cooling operation at AHRI Standard 551/591 test and rating conditions of 7.00°C leaving and 12.00°C entering chilled-fluid liquid temperatures, and with 30.00°C entering and 35.00°C leaving condenser-fluid liquid temperatures shall have maximum full-load (FL) COP and part-load cooling energy efficiency (IPLV.SI) rating requirements, listed in Table 6.8.1-3 and 6.8.1-16, adjusted using the following equations:

\[
FL_{adj} = FL \times K_{adj} \\
IPLV_{adj} = IPLV \times K_{adj}
\]

where

- FL = full-load COP value from Table 6.8.1-3 or 6.8.1-16
- FL adj = minimum full-load COP rating, adjusted for nonstandard conditions
- IPLV = IPLV.SI value from Table 6.8.1-3 or 6.8.1-16
- IPLV adj = minimum NPLV.SI rating, adjusted for nonstandard conditions
- \( A = 0.0000153181 \times (LIFT)^4 - 0.000202076 \times (LIFT)^3 + 0.0101800 \times (LIFT)^2 - 0.264958 \times LIFT + 3.93073 \)
- \( B = 0.0027 \times LvgEvap + 0.982 \)
- LIFT = LvgCond – LvgEvap
- LvgCond = full-load condenser leaving fluid liquid temperature (°C)
- LvgEvap = full-load evaporator leaving liquid temperature (°C)

The FL adj and PLV adj values are only applicable for centrifugal chillers chilling packages meeting all of the following full-load design ranges:

- \( 2.20°C \leq LvgEvap \leq 15.60°C \) and \( 15.56°C \leq LvgCond \leq 46.00°C \) and \( 11.00°C \leq LIFT \leq 44.00°C \)

Manufacturers shall calculate the FL adj and PLV adj before determining whether to label the chiller per Section 6.4.1.5. Compliance with 90.1-2007, 2010, 2013, 2016, 2019, 2022, or combinations thereof, shall be labeled on chillers chilling packages within the scope of the standard.

Centrifugal chillers chilling packages designed to operate outside of these ranges are not covered by this standard.
Example (Section 6.4.1.2.1)
Path A: 2110 kW centrifugal chiller Table 6.8.1-3:

\[
\begin{align*}
\text{FL} & = 6.286 \times \text{COP}_R \\
\text{PLV,SI} & = 7.041 \times \text{COP}_R \\
\text{LvgCond} & = 37.00^\circ C \\
\text{LvgEvap} & = 6.00^\circ C \\
\text{LIFT} & = 37.00 - 6.00 = 31.00^\circ C \\
A & = 0.00000153181 \times (31.00)^4 - 0.000202076 \times (31.00)^3 + 0.0101800 \times (31.00)^2 - 0.264958 \times 31.00 + 3.93073 = 0.894625 \\
B & = 0.0027 \times 6.00 + 0.982 = 0.998200 \\
K_{adj} & = 0.894625 \times 0.998200 = 0.893014 \\
\text{FL}_{adj} & = 6.286 \times 0.893014 = 5.613 \times \text{COP}_R \\
\text{PLV}_{adj} & = 7.041 \times 0.893014 = 6.288 \times \text{COP}_R
\end{align*}
\]

6.4.1.2.2 Positive Displacement (Air- and Water-Cooled) Chilling Packages: Chilling Packages Employing Freeze-Protection Liquids. Equipment with an evaporator leaving fluid temperature higher than 32.00°F and water-cooled positive displacement chilling packages with a condenser leaving fluid temperature below 115.00 shall show compliance with Table 6.8.1-3 when tested or certified with water at standard rating conditions, per the referenced test procedure. Electrically operated chilling packages that employ freeze-protection liquids in any heat exchanger with an application cooling duty evaporator liquid leaving temperature or heating operation source liquid temperature above 0.00°C shall show efficiency compliance as per the applicable requirements in Sections 6.4.1.2.2.1 through 6.4.1.2.2.4.

Absorption chilling packages with freeze-protection liquids are exempt from the efficiency requirements listed in Table 6.8.1-3 and shall only show compliance when applied with water.

6.4.1.2.2.1 All electrically operated cooling-only air-cooled and electrically operated positive displacement liquid-cooled chilling packages shall show compliance with the cooling efficiency requirements listed in Table 6.8.1-3 when applied within the operating limits of AHRI 551/591 at AHRI 551/591 standard rating conditions when tested or rated with water used as a heat transfer liquid.

6.4.1.2.2.2 All liquid-cooled electrically operated cooling-only centrifugal chilling packages shall show compliance with the cooling efficiency requirements listed in Table 6.8.1-3 when applied within the operating limits defined in AHRI 551/591, at the application rating conditions for a cooling efficiency adjusted using $K_{adj}$ as defined in Section 6.4.1.2.1, when tested or rated with water used as a heat transfer liquid.

6.4.1.2.2.3 All electrically operated air-source and electrically operated positive displacement liquid-source heat pump and heat recovery chilling packages shall show compliance with the cooling efficiency requirements listed in Table 6.8.1-16 when applied within the operating limits of AHRI 551/591 at AHRI 551/591 standard rating conditions when tested or rated with water used as a heat transfer liquid. They also shall show compliance with the heating efficiency requirements listed in Table 6.8.1-16 at one of the AHRI 551/591 standard heating rating conditions when tested or rated with water used as a heat transfer liquid. Heating-only chilling packages shall meet the heating efficiency requirements at one of the AHRI 551/591 heating liquid temperature rating conditions and are not required to meet the cooling efficiency requirements of Table 6.8.1-16.

6.4.1.2.2.4 All liquid-source centrifugal heat pump and heat recovery chilling packages shall show compliance with the cooling efficiency requirements listed in Table 6.8.1-16 when applied within the operating limits defined in AHRI 551/591 at the application rating conditions for cooling efficiency, adjusted using $K_{adj}$ as defined in Section 6.4.1.2.1, when tested or rated with water used as a heat transfer liquid. They also shall show compliance with the heating efficiency requirements in Table 6.8.1-16 at one of the AHRI 551/591 standard rating conditions when tested or rated with water used as a heat transfer liquid. Heating-only chillers shall meet the heating efficiency requirements at one of the AHRI 551/591 heating liquid temperature rating conditions and are not required to meet the cooling efficiency requirements of Table 6.8.1-16.
Modify Table 6.8.1-3 to change “water” to “fluid” and correct some of the significant figures in the table to align with the requirements defined in AHRI 550/590 which requires 4 significant figures for efficiency metrics (SI).

Table 6.8.1-3 Water-Liquid-Chilling Packages—Minimum Efficiency Requirements a,b,e,f

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Size Category</th>
<th>Units</th>
<th>Path A</th>
<th>Path B</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-cooled chillers</td>
<td>&lt;528 kW</td>
<td>COP (W/W)</td>
<td>≥5.771 FL</td>
<td>≥5.605 FL</td>
<td>AHRI 551/591</td>
</tr>
<tr>
<td></td>
<td>≥528 kW</td>
<td></td>
<td>≥6.494 FL</td>
<td>≥6.591 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥6.889 FL</td>
<td>≥6.517 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥6.286 IFLV.SI</td>
<td>≥6.001 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥528 kW and &lt;1055 kW</td>
<td></td>
<td>≥5.771 FL</td>
<td>≥5.633 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥1055 kW and &lt;2110 kW</td>
<td></td>
<td>≥6.770 IFLV.SI</td>
<td>≥5.886 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥2110 kW</td>
<td></td>
<td>≥6.286 FL</td>
<td>≥6.018 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥7.041 IFLV.SI</td>
<td>≥9.264 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td>Air-cooled without condenser, electrically operated</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>Air-cooled chillers without condensers must be rated with matching condensers and comply with air-cooled chiller efficiency requirements</td>
<td>AHRI 551/591</td>
<td></td>
</tr>
<tr>
<td>Water-liquid-cooled, electrically operated positive displacement</td>
<td>&lt;264 kW</td>
<td>COP (W/W)</td>
<td>≥4.694 FL</td>
<td>≥4.513 FL</td>
<td>AHRI 551/591</td>
</tr>
<tr>
<td></td>
<td>≥264 kW and &lt;528 kW</td>
<td></td>
<td>≥5.876 IFLV.SI</td>
<td>≥7.041 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥528 kW and &lt;1055 kW</td>
<td></td>
<td>≥5.334 FL</td>
<td>≥5.177 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥1055 kW and &lt;2110 kW</td>
<td></td>
<td>≥6.519 IFLV.SI</td>
<td>≥8.001 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥2100 kW</td>
<td></td>
<td>≥6.286 FL</td>
<td>≥6.018 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥7.041 IFLV.SI</td>
<td>≥9.264 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td>Water-liquid-cooled, electrically operated centrifugal</td>
<td>&lt;528 kW</td>
<td>COP (W/W)</td>
<td>≥5.771 FL</td>
<td>≥5.605 FL</td>
<td>AHRI 551/591</td>
</tr>
<tr>
<td></td>
<td>≥528 kW and &lt;1055 kW</td>
<td></td>
<td>≥6.401 IFLV.SI</td>
<td>≥8.001 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥1055 kW and &lt;1407 kW</td>
<td></td>
<td>≥5.771 FL</td>
<td>≥5.544 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥1407 kW and &lt;2110 kW</td>
<td></td>
<td>≥6.401 IFLV.SI</td>
<td>≥8.801 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥2110 kW</td>
<td></td>
<td>≥6.286 FL</td>
<td>≥6.018 FL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥7.041 IFLV.SI</td>
<td>≥9.264 IFLV.SI</td>
<td></td>
</tr>
<tr>
<td>Air-cooled absorption, single effect</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>≥0.600 FL</td>
<td>NA</td>
<td>AHRI 560</td>
</tr>
</tbody>
</table>

a. The requirements for centrifugal chillers shall be adjusted for nonstandard rating conditions per Section 6.4.1.2.1 and are only applicable for the range of conditions listed there. The requirements for air-cooled, water-liquid-cooled positive displacement and absorption chillers are at standard rating conditions defined in the reference test procedure.
b. Both the full-load and IPLV.SI requirements must be met or exceeded to comply with this standard. When there is a Path B, compliance can be with either Path A or Path B for any application.
c. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
d. NA means the requirements are not applicable for Path B, and only Path A can be used for compliance.
e. FL is the full-load performance requirements, and IPLV.SI is for the part-load performance requirements.
f. Electrically operated chilling packages employing a freeze-protection liquid in accordance with Section 6.4.1.2.2 shall be tested or rated with water for the purpose of compliance with the requirements of this table.
<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Size Category</th>
<th>Units</th>
<th>Path A</th>
<th>Path B</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Liquid-cooled absorption, single effect</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>≥0.7000 FL</td>
<td>NA&lt;sup&gt;d&lt;/sup&gt;</td>
<td>AHRI 560</td>
</tr>
<tr>
<td>Absorption double effect, indirect fired</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>≥1.000 FL</td>
<td>NA&lt;sup&gt;d&lt;/sup&gt;</td>
<td>AHRI 560</td>
</tr>
<tr>
<td>Absorption double effect, direct fired</td>
<td>All capacities</td>
<td>COP (W/W)</td>
<td>≥1.050 &lt;em&gt;IPLV&lt;/em&gt;</td>
<td>NA&lt;sup&gt;d&lt;/sup&gt;</td>
<td>AHRI 560</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥1.000 &lt;em&gt;IPLV&lt;/em&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6.8.1-3 Water Liquid-Chilling Packages—Minimum Efficiency Requirements<sup>a,b,e,f</sup>

| a. The requirements for centrifugal chilling packages shall be adjusted for nonstandard rating conditions per Section 6.4.1.2.1 and are only applicable for the range of conditions listed there. The requirements for air-cooled, water liquid-cooled positive displacement and absorption chilling packages are at standard rating conditions defined in the reference test procedure.
| b. Both the full-load and <em>IPLV</em>.<em>SI</em> requirements must be met or exceeded to comply with this standard. When there is a Path B, compliance can be with either Path A or Path B for any application.
| c. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
| d. NA means the requirements are not applicable for Path B, and only Path A can be used for compliance.
| e. FL is the full-load performance requirements, and <em>IPLV</em>.<em>SI</em> is for the part-load performance requirements.
| f. Electrically operated chilling packages employing a freeze-protection liquid in accordance with Section 6.4.1.2.2 shall be tested or rated with water for the purpose of compliance with the requirements of this table. |
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.
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