

Table 6.8.1-16 Heat Pump and Heat Recovery Water-Chilling Packages—Minimum Efficiency Requirements^k

Equipment Type	Size Category Refrigerating Capacity ⁿ , kW	Cooling Operation Efficiency ^{a,d,e,j} Air Source COP _c (FL/IPLV), W/W Liquid Source COP _c (FL/IPLV), W/W		Heating Operation Efficiency, ^{b,e,j}												Test Procedure	
				Heating Source Conditions (leaving liquid) or OAT (db/wb) ^l , °C	Heat Pump Heating Full Load Heating Efficiency (COP _H) ^{f,h} , W/W				Simultaneous Cooling and Heating Full-Load Efficiency (COP _{SHC}) ^{b,i} , W/W				Heat Recovery Heating Full-Load Efficiency (COP _{HR}) ^{c,j,o} , W/W				
					Entering/Leaving Heating Liquid Temperature				Entering/Leaving Heating Liquid Temperature				Entering/Leaving Heating Liquid Temperature				
					Low	Medium	High	Boost	Low	Medium	High	Boost	Low	Medium	Hot-Water 1		Hot-Water 2
					35.00°C/40.00°C	42.00°C/50.00°C	50.00°C/60.00°C	50.00°C/60.00°C	35.00°C/40.00°C	42.00°C/50.00°C	50.00°C/60.00°C	50.00°C/60.00°C	35.00°C/40.00°C	42.00°C/50.00°C	32.00°C/60.00°C		50.00°C/60.00°C
Liquid-source electrically operated centrifugal	<39.57 ^q and <528.0	≥5.482 FL	≥4.812 FL	7.00 ^m	≥4.760	≥3.610	≥2.660	NA ^p	≥8.550	≥6.290	≥4.390	NA ^p	≥8.550	≥6.290	≥4.829	≥4.390	AHRI 551/591
		≥6.081 IPLV.SI	≥7.601 IPLV.SI	19.00 ^m	NA ^p	NA ^p	NA ^p	≥3.530	NA ^p	NA ^p	NA ^p	≥6.100	NA ^p	NA ^p	NA ^p	NA ^p	
	≥528.0 and <1055	≥5.482 FL	≥5.267 FL	7.00 ^m	≥4.760	≥3.610	≥2.660	NA ^p	≥8.550	≥6.290	≥4.390	NA ^p	≥8.550	≥6.290	≥4.829	≥4.390	
		≥6.081 IPLV.SI	≥8.361 IPLV.SI	19.00 ^l	NA ^p	NA ^p	NA ^p	≥3.530	NA ^p	NA ^p	NA ^p	≥6.100	NA ^p	NA ^p	NA ^p	NA ^p	
	≥1055 and <1407	≥5.972 FL	≥5.621 FL	7.00 ^m	≥4.760	≥3.610	≥2.660	NA ^p	≥8.550	≥6.290	≥4.390	NA ^p	≥8.550	≥6.290	≥4.829	≥4.390	
		≥6.432 IPLV.SI	≥8.576 IPLV.SI	19.00 ^m	NA ^p	NA ^p	NA ^p	≥3.530	NA ^p	NA ^p	NA ^p	≥6.100	NA ^p	NA ^p	NA ^p	NA ^p	
	≥1407 and <2110	≥5.972 FL	≥5.717 FL	7.00 ^m	≥5.060	≥3.880	≥2.950	NA ^p	≥9.140	≥6.850	≥4.960	NA ^p	≥9.140	≥6.850	≥5.456	≥4.960	
		≥6.689 IPLV.SI	≥8.801 IPLV.SI	19.00 ^m	NA ^p	NA ^p	NA ^p	≥3.870	NA ^p	NA ^p	NA ^p	≥6.800	NA ^p	NA ^p	NA ^p	NA ^p	
≥2110	≥5.972 FL	≥5.717 FL	7.00 ^m	≥5.060	≥3.880	≥2.950	NA ^p	≥9.140	≥6.850	≥4.960	NA ^p	≥9.140	≥6.850	≥5.456	≥4.960		
	≥6.689 IPLV.SI	≥8.801 IPLV.SI	24/19.00 ^m	NA ^p	NA ^p	NA ^p	≥3.870	NA ^p	NA ^p	NA ^p	≥6.800	NA ^p	NA ^p	NA ^p	NA ^p		

- a. Cooling rating conditions are standard rating conditions defined in AHRI 551/591 (SI), Table 4, except for liquid-cooled centrifugal chilling packages, which can adjust cooling efficiency for nonstandard rating conditions using K_{adj} procedure in accordance with Section 6.4.1.2.1.
- b. Heating full-load rating conditions are at standard rating conditions defined in AHRI 551/591 (SI), Table 4; includes the impact of defrost for air-source heating ratings.
- c. For liquid-source heat recovery chilling packages that have capabilities for heat rejection to a heat recovery condenser and a tower condenser, the COP_{HR} applies to operation at full load with 100% heat recovery (no tower rejection). Units that only have capabilities for partial heat recovery shall meet the requirements of Table 6.8.1-3.
- d. For cooling operation, compliance with both the FL and IPLV is required, but only compliance with path A or Path B cooling efficiency is required.
- e. For units that operate in both cooling and heating, compliance with both the cooling and heating efficiency is required.
- f. For applications where the chilling package is installed to operate only in heating, compliance only with the heating performance COP_H is required at only one of the heating AHRI 551/591 (SI) standard rating conditions of Low, Medium, High, or Boost. Compliance with cooling performance is not required.
- g. For air-source heat pumps, compliance with both the -8.00°C and 8.00°C heating source outdoor air temperature (OAT) rating efficiency is required for heating.
- h. For heat-pump chilling package applications where the cooling capacity is not being used for conditioning, compliance with the heating performance COP_H is only required at one of the four heating AHRI 551/591 (SI) standard ratings conditions of Low, Medium, High, or Boost. Compliance with the cooling performance is required as defined in footnotes a and d, except as noted in footnote f.
- i. For simultaneous cooling and heating chilling package applications where there is simultaneous cooling and heating, compliance with the simultaneous cooling performance heat recovery COP_{SHC} is only required at one of the four simultaneous cooling and heating AHRI 551/591 (SI) standard ratings conditions of Low, Medium, High, or Boost. Compliance with the cooling-only performance is required as defined in footnotes (a) and (d).
- j. For heat recovery heating chilling package applications where there is simultaneous cooling and heating, compliance with the heating performance heat recovery COP_{HR} is only required at one of the four heating AHRI 551/591 (SI) standard ratings conditions of Low, Medium, Hot-Water 1, or Hot-Water 2. Compliance with the cooling only performance is required as defined in footnotes (a) and (d).
- k. 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.
- l. Outdoor air entering dry-bulb (db) temperature and wet-bulb (wb) temperature.
- m. Source-leaving liquid temperature.
- The cooling evaporator liquid flow rate used for the heating rating for a reverse cycle air-to-water heat pump shall be the flow rate determined during the full load cooling rating.
 - The cooling evaporator liquid flow rate for the simultaneous cooling and heating and heat recovery liquid-cooled chilling packages rating shall be the liquid flow rates from the cooling operation full-load rating.
 - For heating-only fluid-to-fluid chiller packages, the evaporator flow rate obtained with an entering liquid temperature of 12.00°C and a leaving liquid temperature of 7.00°C shall be used.
- n. The size category is the full-load net refrigerating cooling mode capacity, which is the capacity of the evaporator available for cooling of the thermal load external to the chilling package.
- o. A heat recovery condenser at its maximum load point must remove enough heat from the refrigerant to cool the refrigerant to remove all superheat energy and begin condensation of the refrigerant. A heat recovery system where only the superheat is reduced is not covered by Table 6.8.1-16 and is considered a desuperheater, and the chiller package must comply with Table 6.8.1-3.
- p. "NA" means the requirements are not applicable.
- q. Water-to-water heat pumps with a capacity less than 39.57 kW are covered by Table 6.8.1-15.