110.0 to 110.5 All Mandatory Equipment

SUBCHAPTER 2
ALL OCCUPANCIES—MANDATORY REQUIREMENTS FOR THE MANUFACTURE, CONSTRUCTION AND INSTALLATION OF SYSTEMS, EQUIPMENT AND BUILDING COMPONENTS

SECTION 110.0 – SYSTEMS AND EQUIPMENT—GENERAL

Sections 110.1 through 110.~~9~~ 10 establish requirements for manufacturing, construction, and installation of certain systems, equipment and building components that are installed in buildings regulated by ~~Title 24, Part 6~~Part 6. Systems, equipment and building components listed below may be installed only if:

(a) The manufacturer has certified that the system, equipment or building component complies with the applicable manufacturing provisions of Sections 110.1 through 110.~~9~~10; and

(b) The system, equipment or building component complies with the applicable installation provisions of Sections 110.1 through 110.~~9~~10.

No system, equipment or building component covered by the provisions of Sections 110.1 through 110.~~9~~10, that is not certified or that fails to comply with the applicable installation requirements, may be installed in a building regulated by ~~Title 24, Part 6~~Part 6.

The systems, equipment and building components covered are:

Appliances regulated by the Appliance Efficiency Regulations (Section 110.1).

Other space-conditioning equipment (Section 110.2).

Other service water-heating systems and equipment (Section 110.3).

Pool and spa systems and equipment (Section 110.4).

Gas appliances (Section 110.5).

Doors, windows, and fenestration products (Section 110.6).

Joints and other openings (Section 110.7).

Insulation and roofing products (Section 110.8).

Lighting control devices, ballasts, and luminaires (Section 110.9).

Solar Ready Buildings (Section 110.10)

SECTION 110.1 – MANDATORY REQUIREMENTS FOR APPLIANCES REGULATED BY THE APPLIANCE EFFICIENCY REGULATIONS

(a) Any appliance ~~for which there is a California standard established in the~~ regulated by the Appliance Efficiency Regulations, Title 20 ~~(Sections 1601 – 1608 of the~~ California Code of Regulations, section 1601 et seq., ~~Title 20)~~ may be installed only if:

(i) the manufacturer has certified to the Commission, as specified in those regulations, ~~design or performance data that demonstrates~~ that the appliance complies with ~~the~~ all applicable efficiency standards for that appliance, and

(ii)- The appliance appears in the Energy Commission's database of certified appliances, maintained pursuant to 20 Cal. Code Regs., section 1606, and which is available atFor certified appliances, go to www.energy.ca.gov/appliances/database/.

(b) Conformance to Title 24 Part 6-specific efficiency requirements may be verified utilizing design or performance data from either:

(i) the Energy Commission's database of certified appliances publishedmaintained pursuant to 20 Cal. Code Regs., section 1606by the Commission,

(ii) an equivalent directory published by a federal agency,

(iii) an approved trade association directory as defined in 20 Cal. Code Regs., Section 1606(h) of the Appliance Efficiency Regulations, or

(iv) a directory recognized by the Energy Commission as an acceptable source of design or performance data, where such a listing more specifically represents the appliance that must conform to Part 6.

SECTION 110.2 – MANDATORY REQUIREMENTS FOR SPACE-CONDITIONING EQUIPMENT

Certification by Manufacturers. Any space-conditioning equipment listed in this section may be installed only if the manufacturer has certified that the equipment complies with all the applicable requirements of this section.

(a) **Efficiency.** Equipment shall meet the applicable requirements in TABLE 110.2-ATABLE 110.2 ATABLE 110.2 A through TABLE 110.2-GTABLE 110.2-MTABLE 110.2-G, subject to the following:

1. If more than one standard is listed for any equipment in TABLE 110.2-ATABLE 110.2 ATABLE 110.2 A through TABLE 110.2-G TABLE 110.2 MTABLE 110.2 G, the equipment shall meet all the applicable standards that are listed; and

2. If more than one test method is listed in TABLE 110.2-ATABLE 110.2 ATABLE 110.2 A through TABLE 110.2-G TABLE 110.2 MTABLE 110.2 G, the equipment shall comply with the applicable standards when tested with each test method; and

3. Where equipment can serve more than one function, such as both heating and cooling, or both space heating and water heating, it shall comply with all the requirements applicable to each function; and

4. Where a requirement is for equipment rated at its "maximum rated capacity" or "minimum rated capacity," the capacity shall be as provided for and allowed by the controls, during steady-state operation.

EXCEPTION 1 to Section 110.2(a): Water-cooled centrifugal water-chilling packages that are not designed for operation at AHRI Standard 550/590 test conditions of 44°F leaving chilled water temperature and 85°F entering condenser water temperature with 3 gpm/ton condenser water flow shall have a minimum maximum full load COP kW/ton and NPLV ratings adjusted using the following equation:

as shown in TABLE 110.2-H, TABLE 110.2-I, and TABLE 110.2-J, and a minimum NPLV rating as shown in TABLE 110.2-K, TABLE 110.2-L, and TABLE 110.2-M. The table values are only applicable over the following full load design ranges:

Leaving Chiller Water Temp. 40 to 48°F

Entering Condenser Water Temp. 75 to 85°F

Condensing Water Temp. Rise 5 to 15°F

Adjusted maximum full-load kW/ton rating = (full-load kW/ton from Table 110.2-D) / Kadj

Adjusted maximum NPLV rating = (IPLV from Table 110.2-D) / Kadj

Where

Kadj = A * B

A = 0.00000014592 * (LIFT)4 – 0.0000346496 * (LIFT)3 + 0.00314196 * (LIFT)2 – 0.147199 *(LIFT) + 3.9302

LIFT = LvgCond – LvgEvap (°F)

LvgCond = Full-load leaving condenser fluid temperature (°F)

LvgEvap = Full-load leaving evaporator fluid temperature (°F)

B = 0.0015 * LvgEvap + 0.934

The adjusted full-load and NPLV values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

- Minimum Leaving Evaporator Fluid Temperature: 36°F
- Maximum Leaving Condenser Fluid Temperature: 115°F
- LIFT ≥ 20°F and ≤ 80°F

Centrifugal chillers designed to operate outside of these ranges are not covered by this exception.

EXCEPTION 2 to Section 110.2(a): Positive displacement (air- and water-cooled) chillers with a leaving evaporator fluid temperature higher than 32°F, shall show compliance with Table 110.2D when tested or certified with water at standard rating conditions, per the referenced test procedure.

(b) **Controls for Heat Pumps with Supplementary Electric Resistance Heaters.** Heat pumps with supplementary electric resistance heaters shall have controls:

1. That prevent supplementary heater operation when the heating load can be met by the heat pump alone; and
2. In which the cut-on temperature for compression heating is higher than the cut-on temperature for supplementary heating, and the cut-off temperature for compression heating is higher than the cut-off temperature for supplementary heating.

EXCEPTION 1 to Section 110.2(b): The controls may allow supplementary heater operation during:

A. Defrost; and

B. Transient periods such as start-ups and following room thermostat setpoint advance, if the controls provide preferential rate control, intelligent recovery, staging, ramping or another control mechanism designed to preclude the unnecessary operation of supplementary heating.

~~(c)~~

~~Thermostats. All unitary heating and/or cooling systems including heat pumps that are not controlled by a central energy management control system (EMCS) shall have a setback thermostat.~~

~~1. **Setback Capabilities.** All thermostats shall have a clock mechanism that allows the building occupant to program the temperature set points for at least four periods within 24 hours. Thermostats for heat pumps shall meet the requirements of Section 112(b).~~

~~**EXCEPTION to Section 112(c):** Gravity gas wall heaters, gravity floor heaters, gravity room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air-conditioner heat pumps need not comply with this requirement. Additionally, room air-conditioner heat pumps need not comply with Section 112(b). Under performance method of compliance, the resulting increase in energy use due to elimination of the setback thermostat shall be factored into the compliance analysis in accordance with a method prescribed by the Executive Director.~~

(c) ——Thermostats. All unitary heating and/or cooling systems including heat pumps that are not controlled by a central energy management control system (EMCS) shall have an Upgradeable Setback Thermostat (UST) that is certified by the manufacturer to the Energy Commission to meet the requirements of Subsections 110.2(c)(1), 110.2(c)(2), and 110.2(c)3 below:

1. Setback Capabilities. All USTs shall have a clock mechanism that allows the building occupant to program the temperature set points for at least four periods within 24 hours. Thermostats for heat pumps shall meet the requirements of Section 112(b).

2. Upgradeable Capabilities. USTs shall not include onboard communication devices and shall have at least one expansion port which will allow for the installation of a removable module containing a radio or physical connection port to enable communication. The communications capabilities shall enable DEMAND RESPONSIVE CONTROL through receipt of DEMAND RESPONSE SIGNALS based on communications standards (including but not limited to ZigBee (IEEE 802.14.4) and/or WiFi (IEEE 802.11)) and standards based messaging protocols (Smart Energy Profile (SEP), OpenADR and/or others defined in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards (CoS)). Installation of the module shall upgrade the programmable setback thermostat to a communicating setback thermostat. After the communication module is installed and the occupant has enrolled in a DEMAND RESPONSE program or subscribed to a messaging service, the UST shall be capable of both receiving and responding to DEMAND RESPONSE SIGNALS. USTs, with the communication module installed, shall be capable of receiving and responding to the DEMAND RESPONSE SIGNALS as follows:

a. Event Response.

i. Upon initial installation of the communication module by the occupant, the UST shall default to offsets of +4°F for cooling and -4°F for heating relative to the current setpoint in response to DR events or pricing signals. The current setpoint is the setpoint that existed just prior to the current DR event.

ii. The UST shall have the capability to allow occupants or their representative to modify the default offsets with user defined offsets for cooling and heating relative to the current setpoint in response to DR events and pricing signals.

iii. Override Function: Occupants shall be able to change the offsets and thermostat settings or set points at any time, including during DR events.

iv. A DEMAND RESPONSE SIGNAL shall trigger the UST to adjust the thermostat setpoint by either the default number of degrees or as established by the user.

v. When a price signal indicates a price in excess of the price established by the user, the UST shall adjust the thermostat setpoint by either the default number of degrees or as established by the user.

vi. The DEMAND RESPONSE SIGNAL shall start the DEMAND RESPONSE PERIOD either immediately or at a specific start time as specified in the event signal and continue for the DEMAND RESPONSE PERIOD specified in the DEMAND RESPONSE SIGNAL or until the occupant overrides the event set point.

vii. The thermostat's price response shall start either immediately or at a specific start time as specified in the pricing signal and continue for the duration specified in the pricing signal or until the occupant overrides the event set point.

viii. The UST shall have the capability to allow occupants to define setpoints for cooling and heating in response to DR and pricing signals as an alternative to temperature-offsetting response.

ix. At the end of the DEMAND RESPONSE PERIOD, the thermostat set point shall be set to the set point that is programmed for the point in time that the event ends.

3. Other Required Capabilities. USTs shall also have the following capabilities, as further described in Reference Joint Appendix JA5:

a. Physical Connections

i. The expansion/communication port shall be readily accessible to the occupant for installing and removing the communication module.

ii. The equipment interface for the UST to be connected to the HVAC system shall comply with industry standards as described in NEMA DC 3-2008 or subsequent revision of this specification.

b. The capability to display information to the user regarding:

i. communications system connection status

ii. an indication that a event DEMAND RESPONSE PERIOD or pricing event is in progress

iii. other maintenance-related information.

c. The capability to randomize, over a 30-minute period after the end of an event, the time at which the thermostat returns to the programmed setpoint.

d. Include the capability to allow the occupant to restore the default temperature offsets and setpoints to levels specified in 112.(c).2.a.

EXCEPTION 1 to Section 110.2(c): Gravity gas wall heaters, gravity floor heaters, gravity room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air-conditioner heat pumps need not comply with this requirement. Additionally, room air-conditioner heat pumps need not comply with Section 112(b).

EXCEPTION 2 to Section 110.2(c): Other devices within the heating and cooling system capable of providing equivalent demand response functionality described in Section 112(c) that is approved by the Executive Director.

EXCEPTION 3 to Section 110.2(c): In existing buildings including new additions to existing buildings, or in newly constructed buildings where the owner occupant is known, the thermostat or HVAC control system installed may be equipped with onboard communication devices provided that they meet all other technical requirements and be equipped with the capability to turn on or turn off power to the onboard communication device, rendering it inoperative.

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(d) **Gas- and Oil-Fired Furnace Standby Loss Controls.** Gas-fired and oil-fired forced air furnaces with input ratings ≥225,000 Btu/h shall also have an intermittent ignition or interrupted device (IID), and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space. All furnaces with input ratings ≥225,000 Btu/h, including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75 percent of the input rating.

(e) **Evaporative or Open Cooling Towers.** All evaporative or open cooling towers shall be equipped with the following:

1. Conductivity or Flow-based Controls. Towers shall include installation of controls that maximize cycles of concentration based on local water quality conditions. Controls shall automate system bleed and chemical feed based on conductivity, and/or in proportion to metered makeup volume, metered bleed volume, or bleed time. Conductivity controllers shall be maintained in accordance with manufacturer's specifications to maximize useful life and accuracy.

2. Documentation of Maximum Cycles of Concentration. Building owner shall document the maximum cycles of concentration based on local water quality conditions, using the Energy Commission-provided calculator. The calculator is intended to determine maximum cycles based on a Langelier Saturation Index (LSI) of 2.5 or less. Building owner shall document maximum cycles of concentration on Compliance Form MECH 5C, which shall be reviewed and signed by the Professional Engineer (P.E.) of Record.

3. Flow Meter. Towers shall include installation of a flow meter on the makeup water line.

4. Overflow Alarm. Towers shall include installation of an overflow alarm to prevent overflow of the sump in case of makeup water valve failure. Overflow alarm shall send an audible signal or provide an alert via the Building Management System to the tower operator in case of sump overflow.

5. Efficient Drift Eliminators. Towers shall be equipped with efficient drift eliminators that achieve drift reduction to 0.002% of the circulated water volume for counterflow towers and 0.005% for cross-flow towers.

EXCEPTION to Section 110.2(e): Towers with rated capacity < 150 tons.

(f) **Low Leakage Air-Handling Units**. To qualify as low leakage air-handling units for compliance with applicable performance compliance credits, the air-handling unit shall be certified to the Energy Commission according to the specifications in Reference Joint Appendix JA9.

TABLE 110.2-A ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Efficiency a		Test Procedure
		Before 1/1/2015	After 1/1/2015	
Air Conditioners, Air Cooled	> 65,000 Btu/h and < 135,000 Btu/h	11.2 EERb	11.7 EERb	AHRI 340/360
	> 135,000 Btu/h and < 240,000 Btu/h	11.0 EERb	11.7 EERb	AHRI 340/360
	> 240,000 Btu/h and < 760,000 Btu/h	10.0 EERb and 10.1 IPLVb	10.0 EERb and 10.1 IPLVb	
	> 760,000 Btu/h	9.7 EERb and 9.8 IPLVb	9.7 EERb and 9.8 IPLVb	
Air Conditioners, Water and Evaporatively Cooled	> 240,000 Btu/h	11.0 EERb and 11.1 IPLVb		AHRI 340/360
Condensing Units, Air Cooled	> 135,000 Btu/h	10.1 EER and 11.4 IPLV		AHRI 365
Condensing Units, Water or Evaporatively Cooled	> 135,000 Btu/h	13.1 EER and 13.6 IPLV		

a IPLVs are only applicable to equipment with capacity modulation.

b Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

Equipment Type	*Size Category*	*Efficiency* [a]		*Test Procedure*
		Before 1/1/2015	*After 1/1/2015*	
Air Conditioners, Air Cooled	*≥ 65,000 Btu/h and < 135,000 Btu/h*	*110.23 EER* [b]	*11.72 EER* [b]	*ANSI/ARI 340/360*
	≥ 135,000 Btu/h and < 240,000 Btu/h	*119.07 EER* [b]	*11.70 EER* [b]	
	≥ 240,000 Btu/h and < 760,000 Btu/h	*109.05 EER* [b] *and 9.7 IPLV* [b]	*10.0 EER* [b] *and 9.7 IPLV* [b]	*ANSI/ARI 340/360*
	≥ 760,000 Btu/h	*9.72 EER* [b] *and 9.4 IPLV* [b]	*9.7 EER* [b] *and 9.4 IPLV* [b]	
Air Conditioners, Water and Evaporatively Cooled	*> 240,000 Btu/h*	*11.0 EER* [b] *and 10.3 IPLV* [b]		*ANSI/ARI 210/240* *ANSI/ARI 340/360*
Condensing Units, Air Cooled	*≥ 135,000 Btu/h*	*10.1 EER and 11.2 IPLV*		
Condensing Units, Water or Evaporatively Cooled	*≥ 135,000 Btu/h*	*13.1 EER and 13.1 IPLV*		*ANSI/ARI 365*

[a] *IPLVs are only applicable to equipment with capacity modulation*

[b] *Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.*

TABLE 110.2-B UNITARY AND APPLIED HEAT PUMPS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency a		Test Procedure
			Before 1/1/2015	After 1/1/2015	
Air Cooled (Cooling Mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Split System	11.0 EERb	14.0 SEER 11.7 EER	AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h		10.6 EERb		
	> 240,000 Btu/h		9.5 EERb		
Air Cooled (Cooling Mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Single Package	11.0 EERb	14.0 SEER 11.0 EER	AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h		10.6 EERb		
	> 240,000 Btu/h		9.5 EERb		
Air Cooled (Heating Mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Split System	3.3 COP	14.0 SEER 8.2 HSPF	AHRI 340/360
	≥ 135,000 Btu/h		3.2 COP		
Air Cooled (Heating Mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Single Package	3.3 COP	14.0 SEER 8.0 HSPF	AHRI 340/360

~~Equipment Type~~	~~Size Category~~	~~Subcategory or Rating Condition~~	~~Efficiency [a]~~		~~Test Procedure~~
			~~Before 1/1/2015~~	~~After 1/1/2015~~	
~~Air Cooled (Cooling Mode)~~	~~≥ 65,000 Btu/h and < 135,000 Btu/h~~	~~Split System and Single Package~~	~~11.01 EER[b]~~	~~11.0~~	~~ANSI/ARI 340/360~~
	~~≥ 135,000 Btu/h and < 240,000 Btu/h~~		~~10.63 EER[b]~~	~~10.6~~	
	~~≥ 240,000 Btu/h~~		~~9.50 EER[b] and 9.2 IPLV[b]~~	~~9.5 EER[b] and 9.2 IPLV[b]~~	
~~Air Cooled (Heating Mode)~~	~~≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling Capacity)~~	~~47°F db/43°F wb Outdoor Air~~	~~3.32 COP~~	~~3.3 COP~~	~~ANSI/ARI 210/240~~
	~~≥ 135,000 Btu/h (Cooling Capacity)~~	~~47°F db/43°F wb Outdoor Air~~	~~3.21 COP~~	~~3.2 COP~~	~~ANSI/ARI 340/360~~

[a] IPLVs and Part load rating conditions are applicable only to equipment with capacity modulation.

[b] Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 110.2-C AIR-COOLED GAS-ENGINE HEAT PUMPS

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency [a]	Test Procedure
Air-Cooled Gas-Engine Heat Pump (Cooling Mode)	All Capacities	95° F db Outdoor Air	0.60 COP	ANSI Z21.40.4A

Air-Cooled Gas-Engine Heat Pump (Heating Mode)	All Capacities	47° F db/43° F wb Outdoor Air	0.72 COP	ANSI Z21.40.4A

TABLE 110.2-D WATER CHILLING PACKAGES – MINIMUM EFFICIENCY REQUIREMENTS [a,b]

Equipment Type	Size Category	Path A Efficiency	Path B Efficiency	Test Procedure[c]
Air Cooled, With Condenser Electrically Operated	< 150 Tons	≥ 9.562 EER ≥ 12.500 IPLV	N.A.[d]	AHRI 550/590
	≥ 150 Tons	≥ 9.562 EER ≥ 12.750 IPLV	N.A.	
Air Cooled, Without Condenser Electrically Operated	All Capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		
Water Cooled, Electrically Operated, Reciprocating	All Capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		AHRI 550/590
(Reciprocating)				
Water Cooled, Electrically Operated Positive Displacement	< 75 Tons	≤ 0.780 kW/ton ≤ 0.630 IPLV	≤ 0.800 kW/ton ≤ 0.600 IPLV	AHRI 550/590
	≥ 75 tons and < 150 tons	≤ 0.775 kW/ton ≤ 0.615 IPLV	≤ 0.790 kW/ton ≤ 0.586 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.680 kW/ton ≤ 0.580 IPLV	≤ 0.718 kW/ton ≤ 0.540 IPLV	
	≥ 300 Tons	≤ 0.620 kW/ton ≤ 0.540 IPLV	≤ 0.639 kW/ton ≤ 0.490 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	≤ 0.634 kW/ton ≤ 0.596 IPLV	≤ 0.639 kW/ton ≤ 0.450 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.634 kW/ton ≤ 0.596 IPLV	≤ 0.639 kW/ton ≤ 0.450 IPLV	
	≥ 300 tons and < 600 tons	≤ 0.576 kW/ton ≤ 0.549 IPLV	≤ 0.600 kW/ton ≤ 0.400 IPLV	
	≥ 600 Tons	≤ 0.570 kW/ton ≤ 0.539 IPLV	≤ 0.590 kW/ton ≤ 0.400 IPLV	
Air Cooled Absorption, Single Effect	All Capacities	≥ 0.600 COP	N.A.	ANSI/AHRI 560
Water Cooled Absorption, Single Effect	All Capacities	≥ 0.700 COP	N.A.	
Absorption Double Effect, Indirect-Fired	All Capacities	≥ 1.000 COP ≥ 1.050 IPLV	N.A.	
Absorption Double Effect, Direct-Fired	All Capacities	≥ 1.000 COP ≥ 1.000 IPLV	N.A.	

Water Cooled Gas Engine Driven Chiller	All Capacities	≥ 1.2 COP ≥ 2.0 IPLV	N.A.	ANSI Z21.40.4A

~~Table Footnotes:~~

[a] ~~a.~~ No requirements for:

- Centrifugal chillers with designed chilled water supply temperature < 36 F
- Positive displacement chillers with designed chilled water supply temperature < 32F
- Absorption chillers with designed chilled water supply temperature < 40F

[b] ~~b.~~ Must meet both COP and IPLV of the applicable~~either~~ path A or path B

[c] ~~c. S~~see section 100.1 for definitions

[d] ~~d.~~ NA means not applicable

~~e. NR means no minimum requirement in this field.~~

TABLE 110.2-E PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Efficiency [a]	Test Procedure
PTAC (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	12.5 - (0.213 x Cap/1000)[a] EER	ANSI/AHRI/CSA 310/380
PTAC (Cooling Mode) Replacements [b]			10.9 - (0.213 x Cap/1000)[a] EER	
PTHP (Cooling Mode) New Construction			12.3 - (0.213 x Cap/1000)[a] EER	
PTHP (Cooling Mode) Replacements [b]			10.8 - (0.213 x Cap/1000)[a] EER	
PTHP (Heating Mode) New Construction			3.2 - (0.026 x Cap/1000)[a] COP	
PTHP (Heating Mode) Replacements [b]			2.9 - (0.026 x Cap/1000)[a] COP	
SPVAC (Cooling Mode)	< 65,000 Btu/h	95°F db / 75°F wb Outdoor Air	9.0 EER	ANSI/AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h		8.9 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h		8.6 EER	

SPVHP (Cooling Mode)	< 65,000 Btu/h		9.0 EER
	≥ 65,000 Btu/h and < 135,000 Btu/h		8.9 EER
	≥ 135,000 Btu/h and < 240,000 Btu/h		8.6 EER
SPVHP (Heating Mode)	< 65,000 Btu/h		3.0 COP
	≥ 65,000 Btu/h and < 135,000 Btu/h	47°F db / 43°F wb Outdoor Air	3.0 COP
	≥ 135,000 Btu/h and < 240,000 Btu/h		2.9 COP

[a] Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

[b] Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches high and less than 42 inches wide.

TABLE 110.2-G PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT [d]

Equipment Type	**Total System Heat Rejection Capacity at Rated Conditions**	**Subcategory or Rating Condition**	**Performance Required** [a, b]	**Test Procedure** [c]
Propeller or Axial Fan Open Cooling Towers	All	95°F Entering Water 85°F Leaving Water 75 °F wb Outdoor Air	≥ 38.2 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal Fan Open Cooling Towers	All	95°F Entering Water 85°F Leaving Water 75 °F wb Outdoor Air	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Propeller or Axial Fan Open Cooling Towers	All	102°F Entering Water 90°F Leaving Water 75 °F wb Outdoor Air	≥ 14.0 gpm/hp	CTI ATC-105S(96) and CTI STD-201
Centrifugal Fan Open Cooling Towers	All	102°F Entering Water 90°F Leaving Water 75 °F wb Outdoor Air	≥ 7.0 gpm/hp	CTI ATC-105S(96) and CTI STD-201
Air Cooled Condensers	All ~~All~~	125°F Condensing Temperature R22 Test Fluid 190°F Entering Gas Temperature 15°F Subcooling	≥ 176,000 Btu/h•hp	ANSI/AHRI 460

95°F Entering
Drybulb

[a] For purposes of this table, open cooling tower performance is defined as the maximum flow rating of the tower divided by the fan nameplate rated motor power.

[b] For purposes of this table air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan nameplate rated motor power.

[c] Open cooling towers shall be tested using the test procedures in CTI ATC-105. Performance of factory assembled open cooling towers shall be either certified as base models as specified in CTI STD-201 or verified by testing in the field by a CTI approved testing agency. Open factory assembled cooling towers with custom options added to a CTI certified base model for the purpose of safe maintenance or to reduce environmental or noise impact shall be rated at 90% of the CTI certified performance of the associated base model or at the manufacturer's stated performance, whichever is less. Base models of open factory assembled cooling towers are open cooling towers configured in exact accordance with the Data of Record submitted to CTI as specified by CTI STD-201. There are no certification requirements for field erected cooling towers.

[d] The efficiencies for open cooling towers listed in Table 110.2-G are not applicable for closed-circuit cooling towers.

~~*TABLE 110.2-H COPS FOR NON-STANDARD CENTRIFUGAL CHILLERS < 150 TONS*~~

~~**Centrifugal Chillers < 150 Tons**~~

~~**COP_{std} = 5.0**~~

	~~Condenser Flow Rate~~				
~~2 gpm/ton~~	~~2.5 gpm/ton~~	~~3 gpm/ton~~	~~4 gpm/ton~~	~~5 gpm/ton~~	~~6 gpm/ton~~

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT [a] (°F)	Required COP					
46	75	29	5.58	5.83	6.03	6.32	6.54	6.70
45	75	30	5.50	5.74	5.92	6.19	6.38	6.53
44	75	31	5.42	5.65	5.82	6.07	6.24	6.37
43	75	32	5.35	5.57	5.72	5.95	6.11	6.23
42	75	33	5.27	5.49	5.64	5.85	6.00	6.11
41	75	34	5.19	5.41	5.56	5.75	5.89	5.99
46	80	34	5.19	5.41	5.56	5.75	5.89	5.99
40	75	35	5.11	5.33	5.48	5.67	5.79	5.88
45	80	35	5.11	5.33	5.48	5.67	5.79	5.88
44	80	36	5.03	5.26	5.40	5.58	5.70	5.79
43	80	37	4.94	5.18	5.32	5.50	5.62	5.70
42	80	38	4.84	5.10	5.25	5.43	5.53	5.61
41	80	39	4.73	5.01	5.17	5.35	5.46	5.53
46	85	39	4.73	5.01	5.17	5.35	5.46	5.53
40	80	40	4.62	4.92	5.09	5.27	5.38	5.45
45	85	40	4.62	4.92	5.09	5.27	5.38	5.45
44	85	41	4.49	4.82	5.00	5.20	5.30	5.38
43	85	42	4.35	4.71	4.91	5.12	5.23	5.30
42	85	43	4.19	4.59	4.81	5.03	5.15	5.22
41	85	44	4.02	4.46	4.70	4.94	5.06	5.14
40	85	45	3.84	4.32	4.58	4.84	4.98	5.06
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)

[b] Condenser DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$

where X = Condenser DT + LIFT

$COP_{adj} = K_{adj} * COP_{std}$

TABLE 110.2-I COPS FOR NON-STANDARD CENTRIFUGAL CHILLERS > 150 TONS, ≤ 300 TONS

Centrifugal Chillers > 150 Tons, ≤ 300 Tons

COP_{std} = 5.55

Condenser Flow Rate					
2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT [a] (°F)	Required COP					
46	75	29	6.17	6.44	6.66	6.99	7.23	7.40
45	75	30	6.08	6.34	6.54	6.84	7.06	7.22
44	75	31	6.00	6.24	6.43	6.71	6.9	7.05
43	75	32	5.91	6.15	6.33	6.58	6.76	6.89
42	75	33	5.83	6.07	6.23	6.47	6.63	6.75
41	75	34	5.74	5.98	6.14	6.36	6.51	6.62
46	80	34	5.74	5.98	6.14	6.36	6.51	6.62
40	75	35	5.65	5.90	6.05	6.26	6.40	6.51
45	80	35	5.65	5.90	6.05	6.26	6.40	6.51
44	80	36	5.56	5.81	5.97	6.17	6.30	6.40
43	80	37	5.46	5.73	5.89	6.08	6.21	6.30
42	80	38	5.35	5.64	5.80	6.00	6.12	6.20
41	80	39	5.23	5.54	5.71	5.91	6.03	6.11
46	85	39	5.23	5.54	5.71	5.91	6.03	6.11
40	80	40	5.10	5.44	5.62	5.83	5.95	6.03
45	85	40	5.10	5.44	5.62	5.83	5.95	6.03
44	85	41	4.96	5.33	5.55	5.74	5.86	5.94
43	85	42	4.81	5.21	5.42	5.66	5.78	5.86
42	85	43	4.63	5.08	5.31	5.56	5.69	5.77
41	85	44	4.45	4.93	5.19	5.46	5.60	5.69
40	85	45	4.24	4.77	5.06	5.35	5.50	5.59
Condenser DT [b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)

[b] Condenser DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$

where X = Condenser DT + LIFT

$COP_{adj} = K_{adj} * COP_{std}$

TABLE 110.2-J COPS FOR NON-STANDARD CENTRIFUGAL CHILLERS > 300 TONS

Centrifugal Chillers > 300 Tons

COP_{std} = 6.1

	Condenser Flow Rate					
	2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT [a] (°F)	Required COP					
46	75	29	6.80	7.11	7.35	7.71	7.97	8.16
45	75	30	6.71	6.99	7.21	7.55	7.78	7.96
44	75	31	6.61	6.89	7.09	7.40	7.61	7.77
43	75	32	6.52	6.79	6.98	7.26	7.45	7.60
42	75	33	6.43	6.69	6.87	7.13	7.31	7.44
41	75	34	6.33	6.60	6.77	7.02	7.18	7.30
46	80	34	6.33	6.60	6.77	7.02	7.18	7.30
40	75	35	6.23	6.50	6.68	6.91	7.06	7.17
45	80	35	6.23	6.50	6.68	6.91	7.06	7.17
44	80	36	6.13	6.41	6.58	6.81	6.95	7.05
43	80	37	6.02	6.31	6.49	6.71	6.85	6.94
42	80	38	5.90	6.21	6.40	6.61	6.75	6.84
41	80	39	5.77	6.11	6.30	6.52	6.65	6.74
46	85	39	5.77	6.11	6.30	6.52	6.65	6.74
40	80	40	5.63	6.00	6.20	6.43	6.56	6.65
45	85	40	5.63	6.00	6.20	6.43	6.56	6.65
44	85	41	5.47	5.87	6.10	6.33	6.47	6.55
43	85	42	5.30	5.74	5.98	6.24	6.37	6.46
42	85	43	5.11	5.60	5.86	6.13	6.28	6.37
41	85	44	4.90	5.44	5.72	6.02	6.17	6.27
40	85	45	4.68	5.26	5.58	5.90	6.07	6.17
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)

[b] Condenser DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$

where X = Condenser DT + LIFT

$COP_{adj} = K_{adj} * COP_{std}$

TABLE 110.2-K IPLV/NPLV FOR NON-STANDARD CENTRIFUGAL CHILLERS < 150 TONS

Centrifugal Chillers < 150 Tons

$IPLV_{std}$ = 5.25

Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT [a] (°F)	Condenser Flow Rate 2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
			Required IPLV/NPLV					

46	75	29	5.84	6.10	6.30	6.61	6.84	7.00
45	75	30	5.75	6.00	6.19	6.47	6.68	6.83
44	75	31	5.67	5.91	6.08	6.34	6.53	6.67
43	75	32	5.59	5.82	5.99	6.23	6.39	6.52
42	75	33	5.51	5.74	5.90	6.12	6.27	6.39
41	75	34	5.43	5.66	5.81	6.02	6.16	6.26
46	80	34	5.43	5.66	5.81	6.02	6.16	6.26
40	75	35	5.35	5.58	5.73	5.93	6.06	6.15
45	80	35	5.35	5.58	5.73	5.93	6.06	6.15
44	80	36	5.26	5.50	5.65	5.84	5.96	6.05
43	80	37	5.16	5.42	5.57	5.76	5.87	5.96
42	80	38	5.06	5.33	5.49	5.67	5.79	5.87
41	80	39	4.95	5.24	5.41	5.60	5.71	5.78
46	85	39	4.95	5.24	5.41	5.60	5.71	5.78
40	80	40	4.83	5.14	5.32	5.52	5.63	5.70
45	85	40	4.83	5.14	5.32	5.52	5.63	5.70
44	85	41	4.69	5.04	5.25 [c]	5.43	5.55	5.62
43	85	42	4.55	4.93	5.13	5.35	5.47	5.54
42	85	43	4.38	4.80	5.03	5.26	5.38	5.46
41	85	44	4.21	4.67	4.91	5.17	5.30	5.38
40	85	45	4.01	4.52	4.79	5.06	5.20	5.29
Condenser DT [b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)

[b] Condenser DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

[c] All values shown are NPLV except at conditions of 3 gpm/ton and 41 °F LIFT which is IPLV.

$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$

where X = Condenser DT + LIFT

$COP_{adj} = K_{adj} * COP_{std}$

TABLE 110.2-L IPLV/NPLV FOR NON-STANDARD CENTRIFUGAL CHILLERS > 150 TONS, < 300 TONS

Centrifugal Chillers > 150 Tons, < 300 Tons

$IPLV_{std}$ = 5.9

			Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT [a] (°F)	Required IPLV/NPLV					

46	75	29	6.58	6.87	7.11	7.46	7.71	7.90
45	75	30	6.49	6.76	6.98	7.30	7.53	7.70
44	75	31	6.40	6.66	6.86	7.15	7.36	7.52
43	75	32	6.31	6.56	6.75	7.02	7.21	7.35
42	75	33	6.22	6.47	6.65	6.90	7.07	7.20
41	75	34	6.13	6.38	6.55	6.79	6.95	7.06
46	80	34	6.13	6.38	6.55	6.79	6.95	7.06
40	75	35	6.03	6.29	6.46	6.68	6.83	6.94
45	80	35	6.03	6.29	6.46	6.68	6.83	6.94
44	80	36	5.93	6.20	6.37	6.58	6.72	6.82
43	80	37	5.82	6.11	6.28	6.49	6.62	6.72
42	80	38	5.71	6.01	6.19	6.40	6.53	6.62
41	80	39	5.58	5.91	6.10	6.31	6.44	6.52
46	85	39	5.58	5.91	6.10	6.31	6.44	6.52
40	80	40	5.44	5.80	6.00	6.22	6.35	6.43
45	85	40	5.44	5.80	6.00	6.22	6.35	6.43
44	85	41	5.29	5.68	5.90 [c]	6.13	6.26	6.34
43	85	42	5.13	5.55	5.79	6.03	6.16	6.25
42	85	43	4.94	5.41	5.67	5.93	6.07	6.16
41	85	44	4.74	5.26	5.54	5.82	5.97	6.07
40	85	45	4.52	5.09	5.40	5.71	5.87	5.97
Condenser DTb			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)

[b] Condenser DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

[c] All values shown are NPLV except at conditions of 3 gpm/ton and 41 °F LIFT which is IPLV.

$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$

where X = Condenser DT + LIFT

$COP_{adj} = K_{adj} * COP_{std}$

TABLE 110.2-M IPLV/NPLV FOR NON-STANDARD CENTRIFUGAL CHILLERS > 300 TONS

Centrifugal Chillers > 300 Tons

$IPLV_{std}$ = 6.4

			Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT [a] (°F)	Required IPLV/NPLV					

~~46~~	~~75~~	~~29~~	~~7.15~~	~~7.47~~	~~7.72~~	~~8.10~~	~~8.37~~	~~8.58~~
~~45~~	~~75~~	~~30~~	~~7.05~~	~~7.35~~	~~7.58~~	~~7.93~~	~~8.18~~	~~8.36~~
~~44~~	~~75~~	~~31~~	~~6.95~~	~~7.23~~	~~7.45~~	~~7.77~~	~~8.00~~	~~8.16~~
~~43~~	~~75~~	~~32~~	~~6.85~~	~~7.13~~	~~7.33~~	~~7.63~~	~~7.83~~	~~7.98~~
~~42~~	~~75~~	~~33~~	~~6.75~~	~~7.03~~	~~7.22~~	~~7.49~~	~~7.68~~	~~7.82~~
~~41~~	~~75~~	~~34~~	~~6.65~~	~~6.93~~	~~7.12~~	~~7.37~~	~~7.55~~	~~7.67~~
~~46~~	~~80~~	~~34~~	~~6.65~~	~~6.93~~	~~7.12~~	~~7.37~~	~~7.55~~	~~7.67~~
~~40~~	~~75~~	~~35~~	~~6.55~~	~~6.83~~	~~7.01~~	~~7.26~~	~~7.42~~	~~7.54~~
~~45~~	~~80~~	~~35~~	~~6.55~~	~~6.83~~	~~7.01~~	~~7.26~~	~~7.42~~	~~7.54~~
~~44~~	~~80~~	~~36~~	~~6.44~~	~~6.73~~	~~6.92~~	~~7.15~~	~~7.30~~	~~7.41~~
~~43~~	~~80~~	~~37~~	~~6.32~~	~~6.63~~	~~6.82~~	~~7.05~~	~~7.19~~	~~7.30~~
~~42~~	~~80~~	~~38~~	~~6.20~~	~~6.53~~	~~6.72~~	~~6.95~~	~~7.09~~	~~7.19~~
~~41~~	~~80~~	~~39~~	~~6.06~~	~~6.42~~	~~6.62~~	~~6.85~~	~~6.99~~	~~7.08~~
~~46~~	~~85~~	~~39~~	~~6.06~~	~~6.42~~	~~6.62~~	~~6.85~~	~~6.99~~	~~7.08~~
~~40~~	~~80~~	~~40~~	~~5.91~~	~~6.30~~	~~6.52~~	~~6.76~~	~~6.89~~	~~6.98~~
~~45~~	~~85~~	~~40~~	~~5.91~~	~~6.30~~	~~6.52~~	~~6.76~~	~~6.89~~	~~6.98~~
~~44~~	~~85~~	~~41~~	~~5.75~~	~~6.17~~	~~6.40~~ [c]	~~6.66~~	~~6.79~~	~~6.89~~
~~43~~	~~85~~	~~42~~	~~5.57~~	~~6.03~~	~~6.28~~	~~6.55~~	~~6.70~~	~~6.79~~
~~42~~	~~85~~	~~43~~	~~5.37~~	~~5.88~~	~~6.16~~	~~6.44~~	~~6.59~~	~~6.69~~
~~41~~	~~85~~	~~44~~	~~5.15~~	~~5.71~~	~~6.01~~	~~6.33~~	~~6.49~~	~~6.59~~
~~40~~	~~85~~	~~45~~	~~4.91~~	~~5.53~~	~~5.86~~	~~6.20~~	~~6.37~~	~~6.48~~
~~Condenser DT~~ [b]			~~14.04~~	~~11.23~~	~~9.36~~	~~7.02~~	~~5.62~~	~~4.68~~

~~[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)~~

~~[b] Condenser DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)~~

~~[c] All values shown are NPLV except at conditions of 3 gpm/ton and 41 °F LIFT which is IPLV.~~

~~$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$~~

~~where X = Condenser DT + LIFT~~

~~$COP_{adj} = K_{adj} * COP_{std}$~~

SECTION 110.3 – MANDATORY REQUIREMENTS FOR SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT

(a) Certification by Manufacturers. Any service water-heating system or equipment may be installed only if the manufacturer has certified that the system or equipment complies with all of the requirements of this subsection for that system or equipment.

1. Temperature controls for service water-heating systems. Service water-heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use as listed in Table 2, Chapter 9 of the ASHRAE Handbook, HVAC Applications Volume.

   EXCEPTION to Section 110.3(a)1: Residential occupancies.

(b) **Efficiency.** Equipment shall meet the applicable requirements of the Appliance Efficiency Regulations as required by Section 110.1, subject to the following:

1. If more than one standard is listed in the Appliance Efficiency Regulations, the equipment shall meet all the standards listed; and

2. If more than one test method is listed in the Appliance Efficiency Regulations, the equipment shall comply with the applicable standard when tested with each test method; and

3. Where equipment can serve more than one function, such as both heating and cooling, or both space heating and water heating, it shall comply with all the requirements applicable to each function; and

4. Where a requirement is for equipment rated at its "maximum rated capacity" or "minimum rated capacity," the capacity shall be as provided for and allowed by the controls, during steady-state operation.

(c) **Installation.** Any service water-heating system or equipment may be installed only if the system or equipment complies with all of the applicable requirements of this subsection for the system or equipment.

1. Outlet temperature controls. On systems that have a total capacity greater than 167,000 Btu/hr, outlets that require higher than service water temperatures as listed in the ASHRAE Handbook, Applications Volume, shall have separate remote heaters, heat exchangers, or boosters to supply the outlet with the higher temperature.

2. Controls for hot water distribution systems. Service hot water systems with circulating pumps or with electrical heat trace systems shall be capable of automatically turning off the system.

   ~~**EXCEPTION to Section 113(c)2:** Water heating systems serving a single dwelling unit.~~

3. **Temperature controls for public lavatories.** The controls shall limit the outlet temperature to 110°F.

4. **Insulation.** Unfired service water heater storage tanks and backup tanks for solar water-heating systems shall have:

   A. External insulation with an installed R-value of at least R-12; or

   B. Internal and external insulation with a combined R-value of at least R-16; or

   C. The heat loss of the tank surface based on an 80°F water-air temperature difference shall be less than 6.5 Btu per hour per square foot.

5. **Water Heating Recirculation Loops Serving Multiple Dwelling Units, High-Rise Residential, Hotel/Motel and Nonresidential Occupancies.** A water heating recirculation loop is a type of hot water distribution system that reduces the time needed to deliver hot water to fixtures that are distant from the water heater, boiler or other water heating equipment. The recirculation loop is comprised of a supply portion, connected to branches that serve multiple dwelling units, guest rooms, or fixtures and a return portion that completes the loop back to the water heating equipment. A water heating recirculation loop shall meet the following requirements:

   A. **Air release valve or vertical pump installation.** An automatic air release valve shall be installed on the recirculation loop piping on the inlet side of the recirculation pump and no more than 4 feet from the pump. This valve shall be mounted on top of a vertical riser at least 12” in length and shall be accessible for replacement and repair. Alternatively, the pump shall be installed on a vertical section of the return line.

   B. **Recirculation loop backflow prevention.** A check valve or similar device shall be located between the recirculation pump and the water heating equipment to prevent water from flowing backwards though the recirculation loop.

   C. **Equipment for pump priming.** A hose bibb shall be installed between the pump and the water heating equipment. An isolation valve shall be installed between the hose bibb and the water heating equipment. This hose bibb is used for bleeding air out of the pump after pump replacement.

   D. **Pump isolation valves.** Isolation valves shall be installed on both sides of the pump. These valves may be part of the flange that attaches the pump to the pipe. One of the isolation valves may be the same isolation valve as in item C.

   E. **Cold water supply and recirculation loop connection to hot water storage tank.** Storage water heaters and boilers shall be plumbed in accordance with the boiler manufacturer’s specifications. The cold water piping and the recirculation loop piping shall not be connected to the hot water storage tank drain port.

   F. **Cold water supply backflow prevention.** A check valve shall be installed on the cold water supply line between the hot water system and the next closest tee on the cold water supply line. The system shall comply with the expansion tank requirements as described in the California Plumbing Code Section 608.3.

6. **Service water heaters in state buildings.** Any newly constructed building constructed by the State shall derive its service water heating from a system that provides at least 60 percent of the energy needed for service water heating from site solar energy or recovered energy.

   EXCEPTION to Section 110.3(c)6: Buildings for which the state architect determines that service water heating from site solar energy or recovered energy is economically or physically infeasible.

7. Shower Heads. A single shower head must be installed directly on each pipe that terminates at a shower. Shower heads must be placed no closer than four feet from each other, as measured directly from one shower head to the next. Shower heads must have a rated flow rate of no more than 2.0 gallons per minute at 80 psi. Each mixing valve must supply only one shower head. The piping connecting the shower head to the heater or recirculation loop must be no wider than 1/2 inch at any point.

   EXCEPTION to Section 110.3(c)7: Showers that recirculate hot water from the drain to the shower head.

SECTION 110.4 – MANDATORY REQUIREMENTS FOR POOL AND SPA SYSTEMS AND EQUIPMENT

(a) Certification by Manufacturers. Any pool or spa heating system or equipment may be installed only if the manufacturer has certified that the system or equipment has all of the following:

1. Efficiency. A thermal efficiency that complies with the Appliance Efficiency Regulations; and
2. On-off switch. A readily accessible on-off switch, mounted on the outside of the heater that allows shutting off the heater without adjusting the thermostat setting; and
3. Instructions. A permanent, easily readable, and weatherproof plate or card that gives instruction for the energy efficient operation of the pool or spa heater and for the proper care of pool or spa water when a cover is used; and
4. Electric resistance heating. No electric resistance heating; and

   EXCEPTION 1 to Section 110.4(a)4: Listed package units with fully insulated enclosures, and with tight-fitting covers that are insulated to at least R-6.

   EXCEPTION 2 to Section 110.4(a)4: Pools or spas deriving at least 60 percent of the annual heating energy from site solar energy or recovered energy.

(b) Installation. Any pool or spa system or equipment shall be installed with all of the following:

1. Piping. At least 36 inches of pipe shall be installed between the filter and the heater or dedicated suction and return lines, or built-in or built-up connections shall be installed to allow for the future addition of solar heating equipment; and
2. Covers. A cover for outdoor pools or outdoor spas that have a heat pump or gas heater.
3. Directional inlets and time switches for pools. If the system or equipment is for a pool:
   i. The pool shall have directional inlets that adequately mix the pool water; and
   ii. A time switch or similar control mechanism shall be installed as part of the pool water circulation control system that will allow all pumps to be set or programmed to run only during the off-peak electric demand period and for the minimum time necessary to maintain the water in the condition required by applicable public health standards.

SECTION 110.5 – NATURAL GAS CENTRAL FURNACES, COOKING EQUIPMENT, AND POOL AND SPA HEATERS: PILOT LIGHTS PROHIBITED

Any natural gas system or equipment listed below may be installed only if it does not have a continuously burning pilot light:

(a) Fan-type central furnaces.

(b) Household cooking appliances.

EXCEPTION to Section 110.5(b): Household cooking appliances without an electrical supply voltage connection and in which each pilot consumes less than 150 Btu/hr.

(c) Pool heaters.

(d) Spa heaters.