

Mandatory Requirements

Mandatory requirements set forth in Sections 110.1 and 110.3 of the 2013 Building Energy Efficiency Standards (Energy Standards) apply to all DHW appliances, whether the project is newly constructed, an addition or an alteration. These sections establish the requirements for the manufacture, construction, and installation of certain DHW systems, equipment, appliances and building components that are installed in buildings. Section 150.0 includes mandatory requirements for residential DHW systems and insulation.

Minimum Water Heater Efficiency §110.1

Minimum efficiency requirements are based on the type and size of the water heater. Both small and large units are regulated by federal efficiency standards and California's Appliance Efficiency Regulations (Title 20). The California Energy Commission maintains an [Appliance Database](#) that includes regulated equipment certified to comply with Title 20 (see Figure 1 for screenshot).

The delineation between small and large units is determined by the energy input for the type of unit; small gas fired units have a maximum input of 75,000 Btu/hr for storage type units and 200,000 Btu/hr for instantaneous units.

Table 1: Minimum Efficiencies for Common Water Heater Types Manufactured After April 14, 2015

Water Heater Size and Type	Energy Factor (EF)/Thermal Efficiency
Small Gas Storage (≤55 gallons, ≤75 kBtu/hr input)	EF = 0.675 – (0.0015*Volume)
Small Gas Storage (>55 gallons, ≤75 kBtu/hr input)	EF = 0.8012 – (0.00078*Volume)
Small Gas Instantaneous (≤200 kBtu/hr input)	EF = 0.82 – (0.0019*Volume)
Large Gas Storage (any size volume but with an input-to-volume ratio of <4,000 Btu/hr/gal)	Thermal Efficiency = 0.80
Large Gas Instantaneous (≥4,000 Btu/hr/gal)	Thermal Efficiency = 0.80
Additionally, large gas storage units and large gas instantaneous units with a volume of 10 or more gallons must have a maximum standby loss determined by: $\frac{Q}{800} + 110(Vr)^{\frac{1}{2}}$ where Q is the nameplate input and Vr is the rated capacity.	

For minimum efficiencies of electric and oil water heaters, see [Table 5.1 and 5.2](#) in the Residential Compliance Manual.

Installation Requirements §110.3

Section 110.3 includes mandatory installation requirements regarding outlet temperature controls, distribution system controls, storage tank insulation and requirements related to multifamily and state buildings.

Tank and Pipe Insulation Requirements §150.0(i)

Insulation for storage tanks must comply with [Section 150.0\(i\)1](#):

- ★ Minimum R-12 external tank wrap required for storage gas water heaters with an energy factor less than federal minimum standards effective April 2015 (See [CEC Blueprint #109](#)).

- ★ Unfired tanks (such as storage tanks for solar hot water systems or boilers) shall have either R-12 external wrap or internal insulation of R-16.

Internal insulated tanks must include a label on the exterior of the tank showing the R-value.

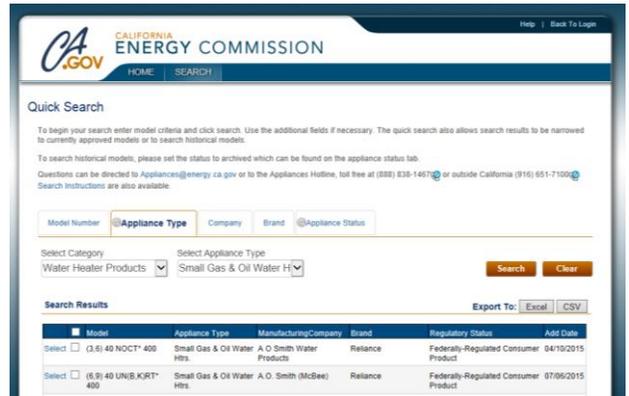


Figure 2: Example search for a water heater in the CEC's Appliance Efficiency Database

Pipe insulation shall comply with [Section 150.0\(j\)2](#). The thickness of the pipe insulation corresponds to the temperature of the water as described in [Table 120.3-A](#). For DHW systems with fluid temperatures between 100-140°F, pipe insulation thickness ranges from 1-1.5 inches depending on the diameter of the pipe. Pipe insulation is a mandatory requirement in the following cases:

- ★ The first 5 feet of hot & cold water pipes from storage tank;
- ★ All piping with a nominal diameter of 3/4 inch or larger;
- ★ All piping associated with a domestic hot water recirculation system regardless of the pipe diameter;
- ★ Piping from heating source to storage tank or between tanks;
- ★ Piping buried below grade;
- ★ All hot water pipes from heating source to kitchen fixtures.

See [Section 150.0\(j\)2](#) for exceptions to pipe insulation requirements.

Section 150.0(j)3 contains requirements for insulation protection, including requirements around pipes exposed to weather and vapor retarders for chilled water or refrigerant suction piping.

Water Heater System Requirements §150.0(n)

Systems using gas or propane water heaters to serve individual dwelling units shall include the following components:

- ★ A 120V electrical receptacle that is within 3 feet from the water heater and accessible to the water heater with no obstructions; and
- ★ A Category III or IV vent, or a Type B vent with straight pipe between the outside termination and the space where the water heater is installed; and
- ★ A condensate drain that is no more than 2 inches higher than the base of the installed water heater, and allows natural draining without pump assistance, and
- ★ A gas supply line with a capacity of at least 200,000 Btu/hr.

Prescriptive Requirements

If using the prescriptive compliance path, DHW equipment serving individual dwelling units (detached single family homes, low-rise multifamily buildings) must comply with one of the following options, per [§150.1\(c\)8](#):

- ✦ **Storage Type Water Heaters:** A gas or propane fired unit with an input of 75,000 Btu/hr or less
- ✦ **Instantaneous Type Water Heaters:** A gas or propane fired unit with an input of 200,000 Btu/hr or less
- ✦ **Electric Resistance Water Heaters:** Electric resistance storage or instantaneous type water heaters may only be installed if natural gas is unavailable, the unit is located within the building envelope, and a solar water heating system with a minimum solar savings fraction of 0.50 is installed.

For electric resistance water heaters, recirculation pumps shall not be used. For recirculation distribution systems using gas storage and gas instantaneous water heaters, only Demand Recirculation Systems with manual control pumps shall be used. Additional detail on each option can be found in [§150.1\(c\)8](#).

Multifamily Buildings

DHW systems serving multiple dwelling units (those in low-rise or high-rise multifamily buildings) may install larger water heating equipment meeting the minimum energy efficiency requirements set forth in [Section 110.1](#) and [Section 110.3](#), summarized on [Table 5.2](#) and in this document. For more information regarding both low and high rise residential buildings and water heating requirements, refer to our [Multifamily Fact Sheet](#).

HERS-Verified Recirculation Strategies

Several recirculation strategies require verification by a HERS rater and center around demand recirculation. Demand Recirculation systems require that the pump operation is initiated just before the hot water draw and is operated by either a manual or sensor control which shuts off the pump due to a rise in pipe temperature. The following are requirements for these systems:

- ✦ **Demand Recirculation: Manual Control**—shall be located in the kitchen and any point of use at least 20 feet away from the water heater. The manual control may be operated by wired or wireless mechanisms but must have a standby power of 1 watt or less.
- ✦ **Demand Recirculation: Sensor Control**—shall be located in the kitchen and any point of use at least 20 feet away from the water heater. The sensor mechanism may include motion sensors, door switches, and flow switches, and must have a standby power of 1 watt or less.

With either strategy, the control shall shut off the pump in accordance with the following methods:

- ✦ After the pump has been activated, the controls shall allow the pump to operate until the water temperature at the thermo-sensor rises no more than 10°F above the initial temperature of the water in the pipes, or
- ✦ The controls shall not allow the pump to operate when the temperature exceeds 102°F

The controls shall limit pump operation to a maximum of 5 minutes following ANY activation.

Recirculation in Multifamily Buildings

Prescriptively, central DHW systems serving more than eight dwelling units shall have at least two recirculation loops, each serving roughly the same number of units.

Addition and Alteration Projects

All of the mandatory requirements discussed above apply to addition and alteration projects except that existing inaccessible piping does not require pipe insulation, and system requirements from Section 150.0(n) do not apply unless an addition project is adding a water heater.

Many addition and especially alteration projects will use the prescriptive compliance path, and [§150.2\(a\)1D](#) gives more detail on prescriptive requirements for additions, while [§150.2\(b\)1G](#) gives detail on prescriptive requirements for alterations. These sections offer compliance through meeting the requirements of [§150.1\(c\)8](#), which is described above, or alternative compliance paths if these requirements can't be met under existing conditions.

The CEC has published a [Minimum Water Heater Energy Factor Reference Guide](#), see page 2 for guidance on replacement heat pump water heaters.

Compliance Credit for Performance Path

Compliance credit for DHW distribution is available for several different strategies, including one non-HERS credit (PIA) and four HERS distribution credits:

- ✦ Pipe insulation (PIA)
- ✦ Pipe insulation (PIC-H)
- ✦ Parallel Piping with 5' maximum length (PP-H)
- ✦ Compact Design (CHWDS-H)
- ✦ Point of Use (POU-H)

Solar Water Heating

The Water Heating Calculation Method allows water heating credits for solar water heaters. Solar systems save energy by using renewable resources to offset the use of conventional energy sources.

Solar water heating is prescriptively required for systems serving single family dwelling units with electric water heaters (restrictions apply). Solar water heating is also prescriptively required for water heating systems serving multiple dwelling units, whether they are multifamily, hotel/motels or high-rise nonresidential buildings.

Collector Requirements

Collectors for solar water heating systems used to meet the requirements of the Energy Standards (such as those for installing electric resistance water heating units or DHW systems serving multiple dwelling units) must be certified by the Solar Rating and Certification Corporation (SRCC). Additionally the installed collector or system must be either OG-100 or OG-300 certified:

- ✦ **OG-100** certification applies only to the collector, the part of the solar energy system exposed to the sun collecting heat
 - For a listings of compliant products please refer to the [SRCC Collector Ratings](#)
- ✦ **OG-300** certification integrates the performance of the collector with a performance model of the entire system and must be installed with the following guidelines:
 - Face within 35 degrees of due south
 - Have a tilt slope of at least 3:12
 - Be unshaded by buildings or trees

For more specific installation guidelines, see [Residential Appendix 4.4.21](#).

