2019 Energy Code
Water Heating – Low-Rise Residential

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Outreach and Education

Efficiency Division

Goals of this Training

Review the Energy Code requirements for water heating systems for low-rise residential buildings

- All Occupancies
  - Mandatory requirements, features, and devices
- Newly Constructed Buildings
  - Mandatory
  - Prescriptive
- Existing Buildings - Additions and alterations
  - Prescriptive

Questions…

Please feel free to ask at anytime!

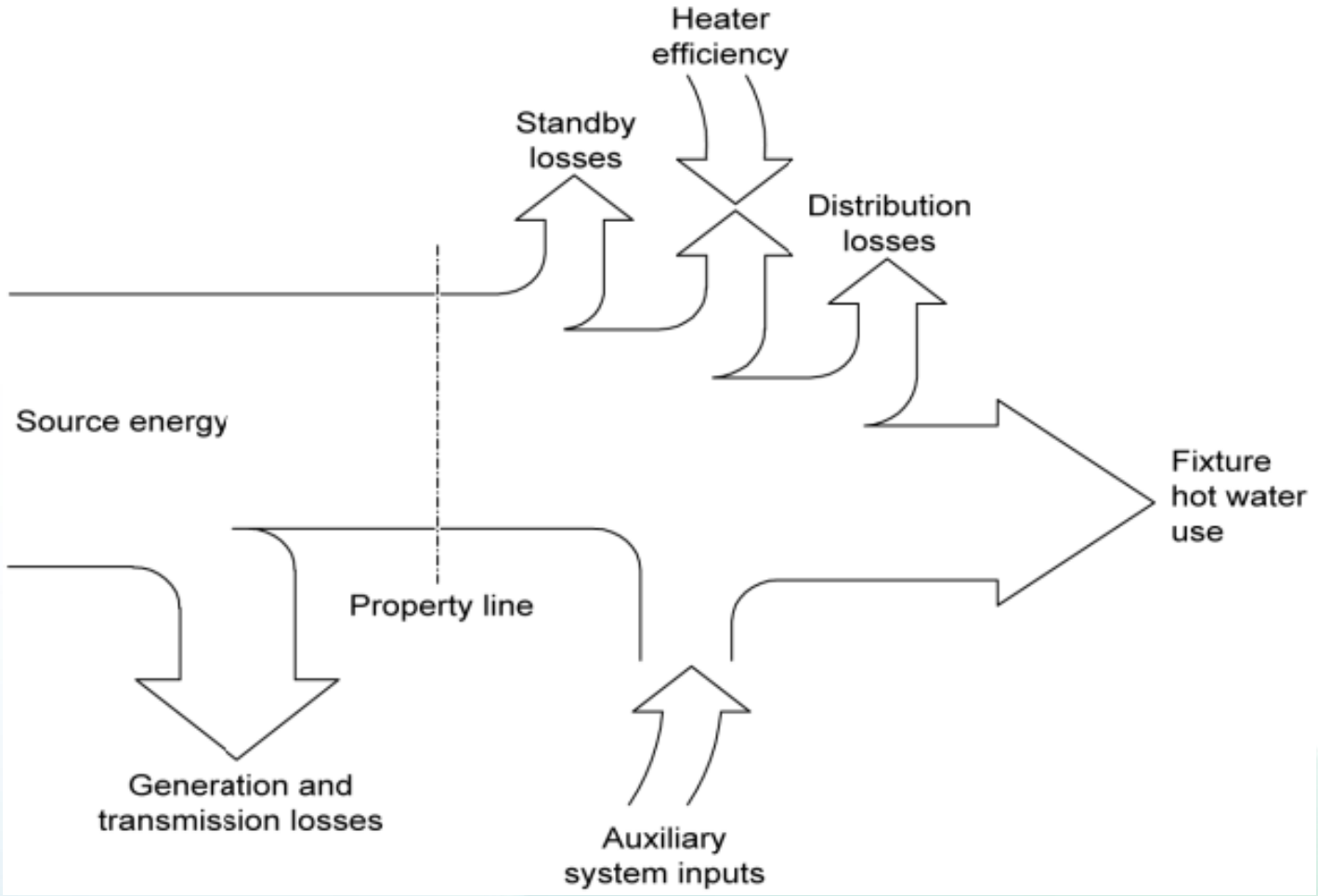
- During training
- At break
- Afterwards

- **Your questions enhance the class**

Energy Commission History

- Warren-Alquist Act created the Energy Commission (CEC) in 1974 and gave it authority to develop and maintain Energy Code
- Standards must be cost-effective over the structure's economic life (usually calculated using 30 years)
- CEC updates the Energy Code every 3 years

Why Do We Have Water Heating Energy Standards?



Approaches

- **Mandatory** - measures that must be met, regardless of compliance approach; cannot be traded-off
- **Prescriptive Approach**
  - "Grocery lists" of requirements, sometimes superseding mandatory measures
  - All-or-nothing; different requirements for new construction, additions, and alterations
  - Defines the standard building baseline (see Performance Approach)

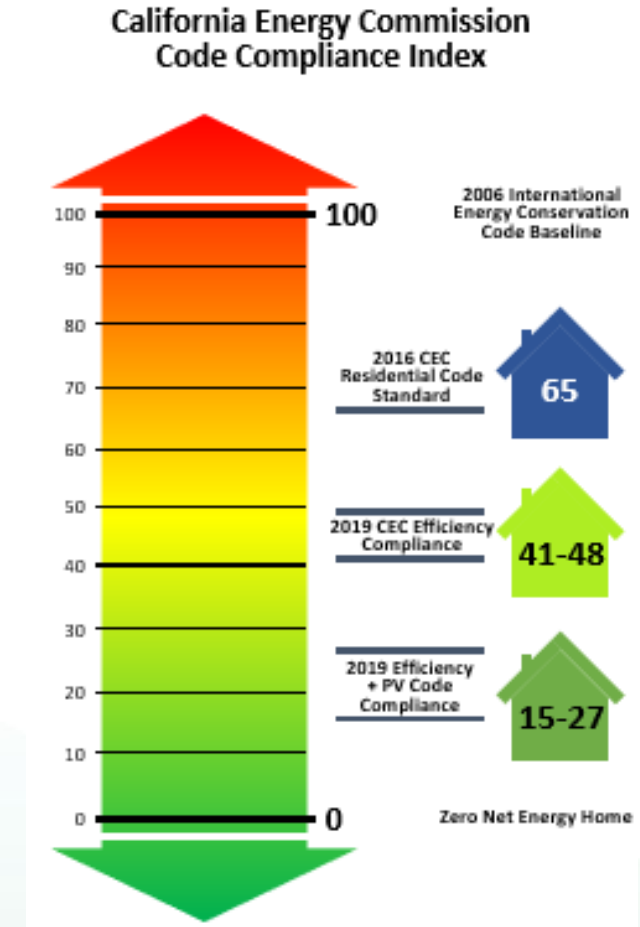
Approaches, cont.

- **Performance Approach –**
  - More flexible; allows more efficient features to make up for less efficient ones
  - Uses CEC-approved modeling software (more later) to show that the proposed design's energy use is less than that of the standard design (Prescriptive approach)
    - Proposed design EDR ≤ standard design EDR (new construction)
    - Proposed design TDV ≤ standard design TDV (additions & alterations)

What is EDR?

Energy Design Rating (EDR) score is based on total estimated energy use

- 100 represents a home built to 2006 IECC; 0 represents a zero net energy home
- Two kinds of EDR score must be met individually (more later)



Energy Design Rating (EDR), as defined by the California Energy Commission, is an alternate way to express the energy performance of a building using a scoring system where 100 represents the energy performance of a Residential Energy Services (RESNET) reference home characterization of the 2006 IECC with California modeling assumptions. A score of 0 represents the energy performance of a building that combines high levels of energy efficiency with renewable generation to "zero out" its TDV energy.

What is a Low-Rise Residential Building?

- Single family - any number of stories
- Duplexes - any number of stories
- Townhouses - no more than three habitable stories
- Multifamily - no more than three habitable stories

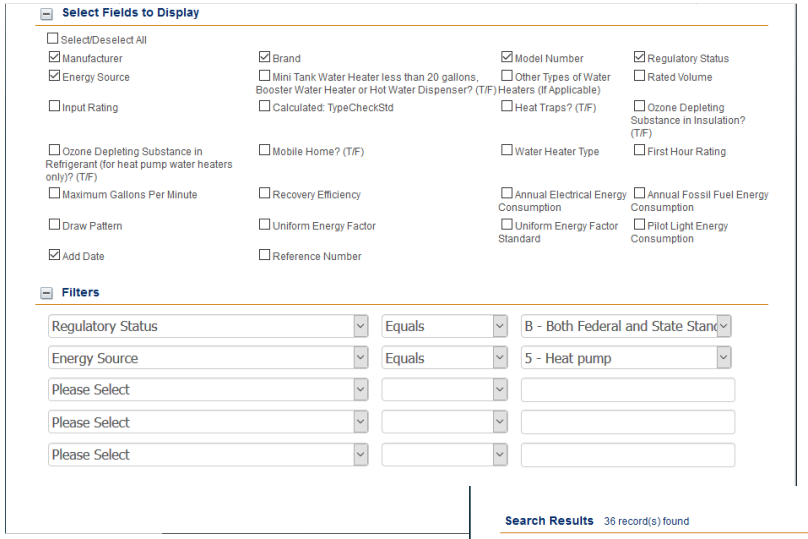
§§ 110.1 & 110.3

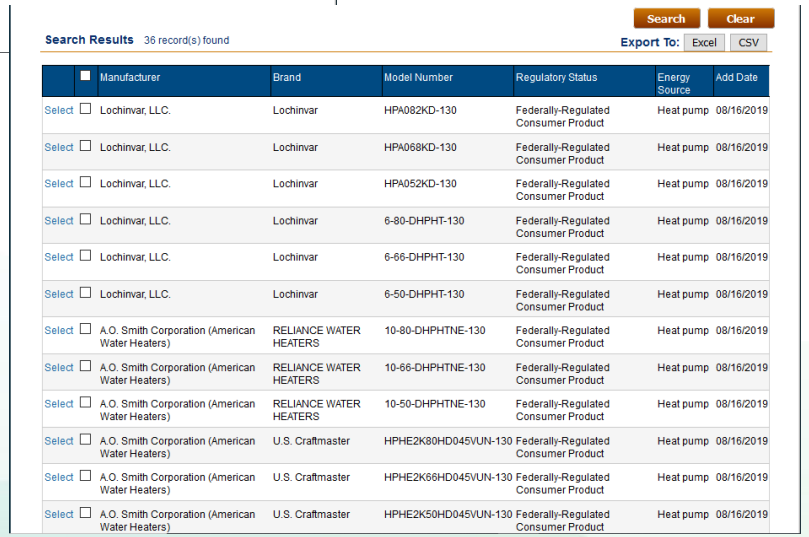
MANDATORY REQUIREMENTS – ALL OCCUPANCIES

§§ 110.1(a)&(b) - Mandatory Requirements; Appliances

a) A water heater is allowed to be installed only if it meets Title 20 minimum efficiencies (see Title 20, §1605.1, Table F-2 and F-5)

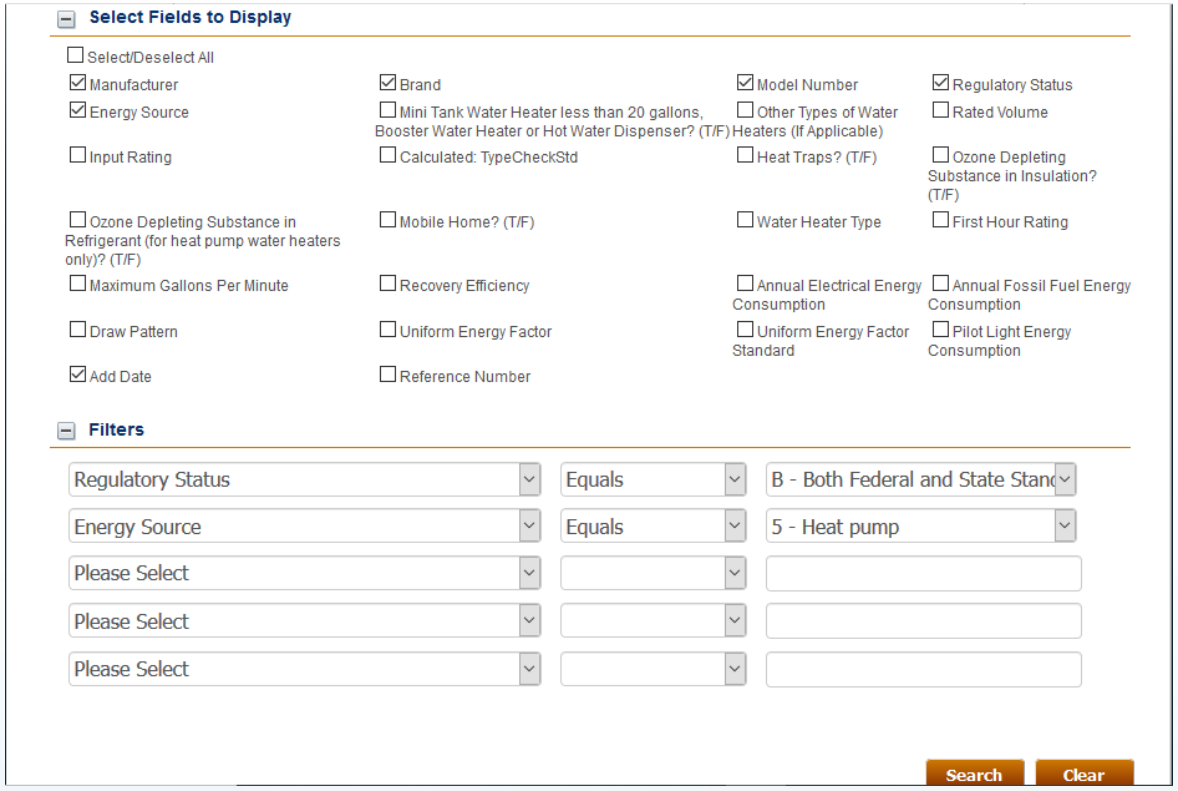
b) Verify the water heater's efficiency using MAEDbS database, an equivalent federal directory, or an approved trade association directory (more later)

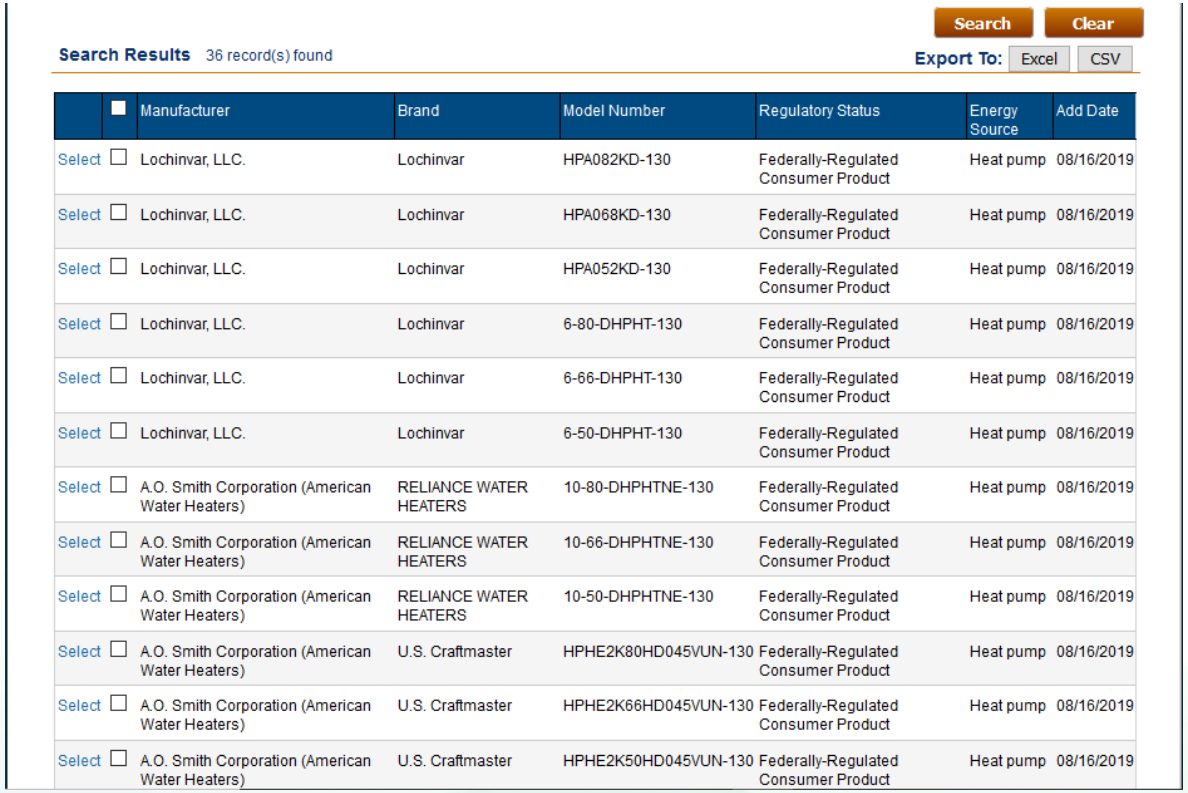




Look up appliances on the Modernized Appliance Efficiency Database

A Closer Look at MAEDbS





		Manufacturer	Brand	Model Number	Regulatory Status	Energy Source	Add Date
Select	☐	Lochinvar, LLC.	Lochinvar	HPA082KD-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	Lochinvar, LLC.	Lochinvar	HPA068KD-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	Lochinvar, LLC.	Lochinvar	HPA052KD-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	Lochinvar, LLC.	Lochinvar	6-80-DHPHT-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	Lochinvar, LLC.	Lochinvar	6-66-DHPHT-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	Lochinvar, LLC.	Lochinvar	6-50-DHPHT-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	A.O. Smith Corporation (American Water Heaters)	RELIANCE WATER HEATERS	10-80-DHPHTNE-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	A.O. Smith Corporation (American Water Heaters)	RELIANCE WATER HEATERS	10-66-DHPHTNE-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	A.O. Smith Corporation (American Water Heaters)	RELIANCE WATER HEATERS	10-50-DHPHTNE-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	A.O. Smith Corporation (American Water Heaters)	U.S. Craftmaster	HPHE2K80HD045VUN-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	A.O. Smith Corporation (American Water Heaters)	U.S. Craftmaster	HPHE2K66HD045VUN-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019
Select	☐	A.O. Smith Corporation (American Water Heaters)	U.S. Craftmaster	HPHE2K50HD045VUN-130	Federally-Regulated Consumer Product	Heat pump	08/16/2019

§ 110.1(c) - Mandatory Requirements; Appliances

- Conformance with efficiencies required by Part 6 must be demonstrated by default to the mandatory efficiencies, or procedures approved per Part 1, §10-109, when:

    1. Data to verify conformance is not available
    2. Field verification and diagnostic testing required, but no CEC-approved protocol for that appliance
    3. On-site modifications affect its performance
    4. US DOE waived federal test procedures, but waiver doesn't say how to determine the efficiency

§§ 110.3(a)&(b) - Mandatory Requirements; Service Water-Heating

(a) Only systems and equipment manufacturer-certified as meeting §110.3 are allowed to be installed

(b) Water heating equipment must meet all Title 20 requirements (see Title 20, §1605.1(f)), including:

1. Meeting all listed standards
2. Meeting standards via all listed test methods
3. Meet all requirements for all functions
4. If the requirement is for equipment at the min/max rated capacity, the controls must make that capacity possible at steady-state operation

§ 110.3(c)1 - Mandatory Requirements; Service Water-Heating Installation

Systems > 167,000 BTU/hr – outlets needing higher-than-service water temperatures (ASHRAE Handbook), must have separate remote heaters, heat exchangers, or boosters to supply the higher temperature:

- EXCEPTION: Systems covered by CA Plumbing Code, §613.0 must follow those requirements

§§ 110.3(c)2&3 - Mandatory Requirements; Service Water-Heating Installation

2. Service hot water systems with circulating pumps or electrical heat trace systems must be able to auto-shutoff.
   - EXCEPTION: Systems serving healthcare facilities
3. Unfired service water heater storage tanks and solar water heating backup tanks must <u>have/meet one of</u>:
   A. External insulation, R-12 or more
   B. Internal and external insulation, R-16 or more (combined)
   C. Tank surface heat loss < 6.5 BTU per hour per square foot (water-air temperature difference of 80°F)

§ 110.3(c)4 - Mandatory Requirements; Service Water-Heating Installation

Recirculation loops serving multiple dwelling units must meet/have all of:

A. Air release valve or vertical pump installation

B. Recirculation loop backflow prevention

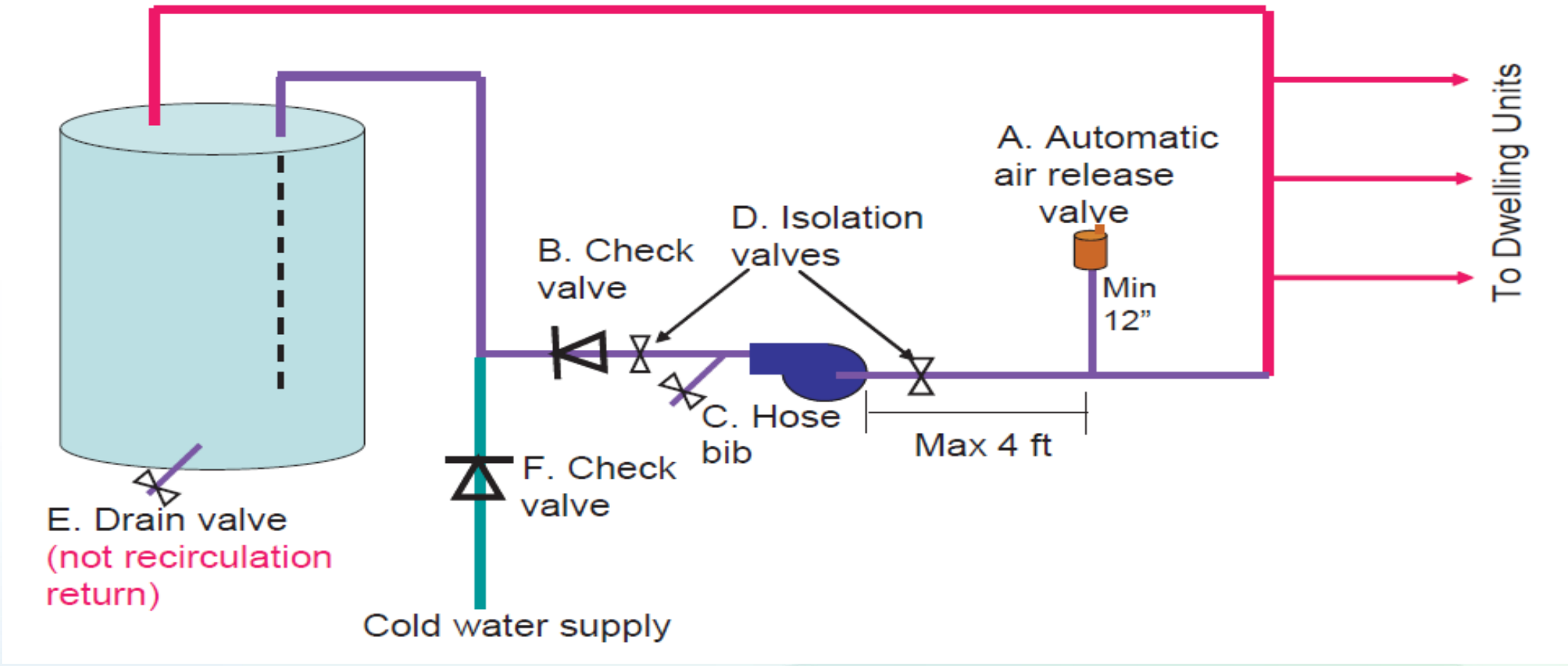
C. Equipment for pump priming

D. Pump isolation valves

E. Cold water supply and recirculation loop piping cannot connect to the hot water storage tank drain port

F. Cold water supply backflow prevention

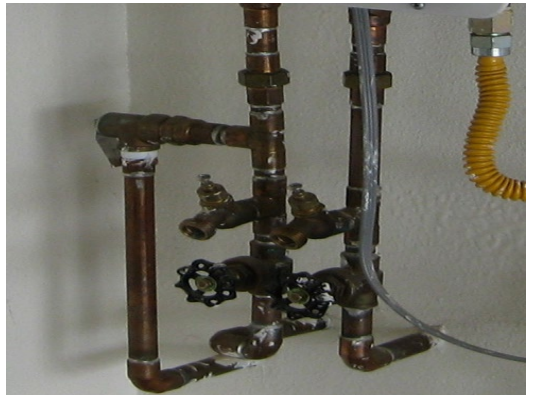
§ 110.3(c)4 - Example



§ 110.3(c)6 – Mandatory Requirements; Service Water-Heating Installation

- Isolation valves
  - Required for instantaneous (“tankless”) water heaters > 6.8 kBTU/hr (2 kW)
  - Must be installed on both cold and hot water lines, each with hose bibbs or other fittings for maintenance flushing

Source: http://andrews-plumbing.com



§ 110.3(c)6 - Example

Source: homedepot.com

§ 110.1 - SUMMARY

- Water heaters must be manufacturer-certified as meeting Title 20 to be installed
- Verify water heater efficiency using MAEDbS or other approved directory
  - If it's required to be certified under Title 20, it must be in MAEDbS to be sold and installed in California
- Demonstrate conformance with required efficiency by default to the mandatory efficiency, or approved procedures if data to verify is not available, there is no CEC-approved field verification testing protocol, on-site modifications affect performance, or the federal test waiver doesn't say how to determine the efficiency

§ 110.3 – SUMMARY

- Water heaters must be tested per, and manufacturer-certified as meeting, Title 20 requirements
- Separate heaters for above-service temperature outlets (> 167,000 BTU/hr)
- Auto-shutoff controls for systems with circulation pumps or electric heat trace systems
- Unfired water heating tanks and solar water heating backup tanks must have required insulation/tank surface heat loss
- Recirculation loops serving multiple dwelling units must meet plumbing/installation requirements (diagram)
- Isolation valves and fittings for tankless water heaters > 6.8 kBTU/hr (2kW)

§ 150.0

MANDATORY FEATURES AND DEVICES – LOW-RISE RESIDENTIAL

§ 150.0(j)1 – Tank Insulation

Unfired hot water tanks (e.g., storage tanks, back-up storage tanks for solar water heating) must be insulated with one of the following:

- R-12 or higher, external wrap
- R-16 or higher, internal (must be externally labeled)

§ 150.0(j)2 – Pipe Insulation Thickness and Conductivity

A. All hot water piping must be insulated per CA Plumbing Code, § 609.11. Also, the following piping conditions require insulation ≥ 1" thick, or R-value ≥ 7.7:
    i. 1st 5 ft. of cold water pipes from storage tank
    ii. All hot water piping ≥ ¾" to > 1", in diameter
    iii. All hot water piping < ¾" in diameter that is:
        a. Part of a domestic hot water recirculation system
        b. Between the heating source and kitchen fixtures
        c. Between the heating source and a tank, or between tanks
        d. Buried below grade

B. Insulate solar water heating collector loop piping, per TABLE 120.3-A, or the equation in §120.3(c)2

Using TABLE 120.3-A

Insulate pipes according to TABLE 120.3-A.

TABLE 120.3-A PIPE INSULATION THICKNESS

Fluid Operating Temperature Range (°F)	Insulation Conductivity			Nominal Pipe Diameter (in inches)				
	Conductivity (in Btu·in/h·ft²·°F)	Mean Rating Temperature (°F)		< 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
Space heating and Service Water Heating Systems (Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)				Minimum Pipe Insulation Required (Thickness in inches or R-value)				
Above 350	0.32-0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R-value	R 37	R 41	R 37	R 27	R 23
251-350	0.29-0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R-value	R 24	R 34	R 35	R 26	R 22
201-250	0.27-0.30	150	Inches	2.5	2.5	2.5	3.0	3.0
			R-value	R 21	R 20	R 17.5	R 17	R 14.5
141-200	0.25-0.29	125	Inches	1.5	1.5	2.0	2.0	2.0
			R-value	R 11.5	R 11	R 14	R 11	R 10
105-140	0.22-0.28	100	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 7.7	R 12.5	R 11	R 9	R 8

TABLE 120.3-A now allows for insulation by thickness OR R-values

Using TABLE 120.3-A (Example)

TABLE 120.3-A PIPE INSULATION THICKNESS

Fluid Operating Temperature Range (°F)	Insulation Conductivity: Conductivity (in Btu·in/h·ft²·°F)	Insulation Conductivity: Mean Rating Temperature (°F)		Nominal Pipe Diameter (in inches): < 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
Space heating and Service Water Heating Systems (Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)				Minimum Pipe Insulation Required (Thickness in inches or R-value)				
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			R-value	R 11.5	R 11	R 14	R 11	R 10
105-140	0.22-0.28	100	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 7.7	R 12.5	R 11	R 9	R 8

- Let's say you have:
  - Domestic hot water (DHW) pipe < 1 inch in diameter
  - Water temperature will be 105 – 140°F
  - Pipe insulation with a conductivity of 0.22 – 0.28 BTU-inch per hour-square foot-degree F
- *Then your pipe must be insulated to 1.0 inches thick, OR an R-value of R-7.7*

§ 120.3(c)2 – Insulation Thickness

If your insulation has a conductivity range not on TABLE 120.3-A, use this equation to calculate the thickness:

$$T = PR \times ((1 + (t/PR)^{K/k} - 1)$$

T = minimum insulation thickness, for material with conductivity K (inches)

PR = pipe outer radius (inches)

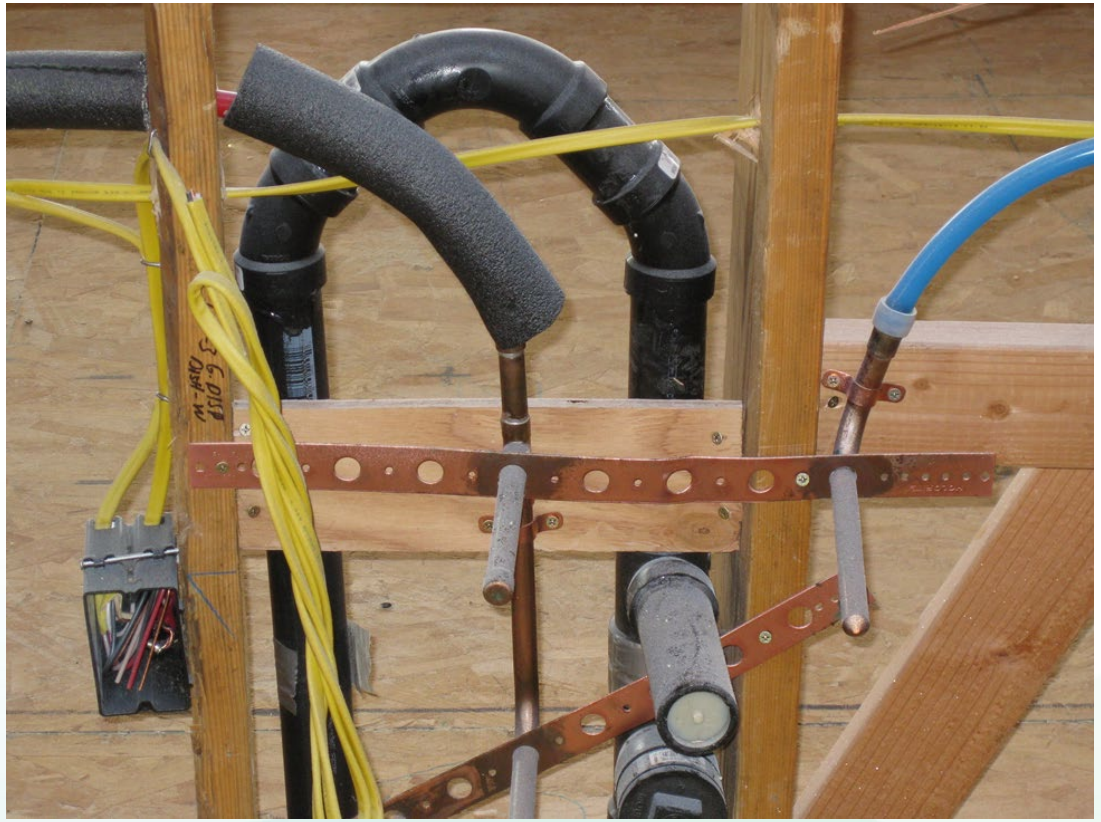
T = insulation thickness, from TABLE 120.3-A (inches)

K = conductivity of alternate material at the mean rating temperature in TABLE 120.3-A for the applicable fluid temperature range (BTU-inch per hour per square foot, per °F)

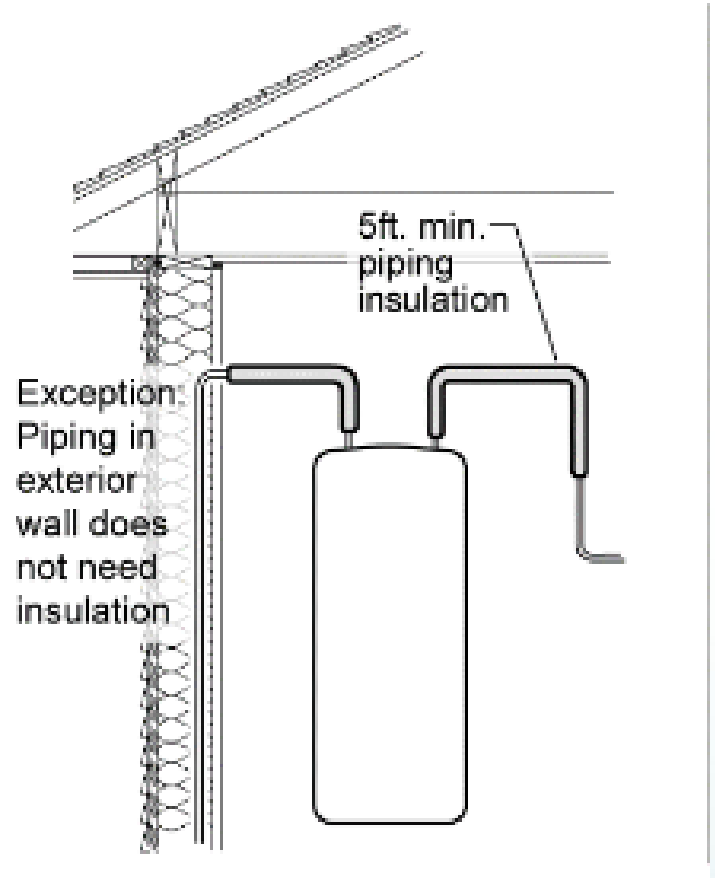
K = lower value of the conductivity range in TABLE 120.3-A for the applicable fluid temperature range (BTU-inch per hour per square foot, per °F)

§ 150.0(j)2 – Pipe Insulation, Exception 2

- Portions of piping penetrating framing members don’t require insulation.
- Metal piping penetrating metal framing requires tight-fitting grommets, plugs, wrapping or other insulation to prevent metal-to-metal contact.

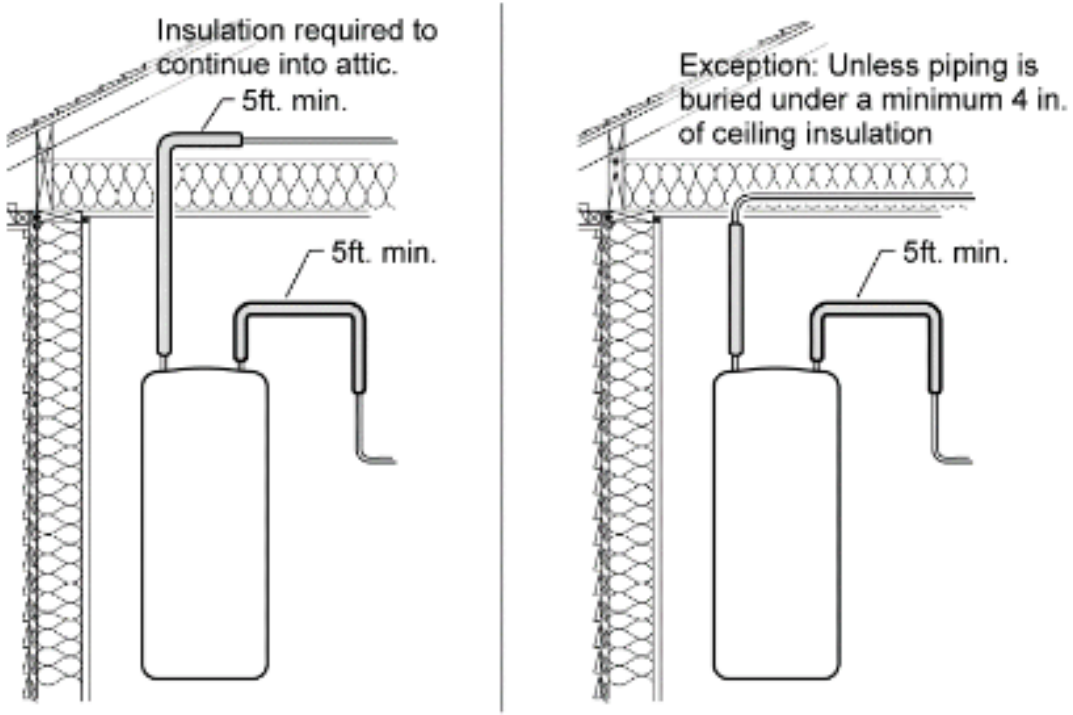


§ 150.0(j)2 – Pipe Insulation, Exception 3



- Piping installed in exterior and interior walls *meeting Quality Insulation Installation (QII) requirements* don't need pipe insulation

§ 150.0(j)2 – Pipe Insulation, Exception 4



- Pipes surrounded with 1” of wall, 2” of crawlspace, or 4” of attic insulation don’t need pipe insulation
- *No QII required!*

Pipe Insulation Credit

- Compliance credit is available for hot water pipe insulation, per RA3.6.3
  - Have HERS inspection to verify correct insulation of all hot water piping
  - See the requirements in the CF2R-PLB-22-H and CF3R-PLB-22-H
  - CF2R and CF3R forms must be registered with a HERS provider

§ 150.0(j)3 – Insulation Protection

- Insulation exposed to weather (per §120.3(b)):

  1. Must have a water retardant, sun-resistant cover suitable for outdoors; NO TAPE!

  3. If buried below grade, must have waterproof, uncrushable casing/sleeve

§ 120.3(b) - Insulation Protection

Protect insulation from weather and maintenance.

1. Insulation exposed to weather must have an outdoor-suitable cover.
    - Solar-resistant and water retardant.
    - Protection cannot be adhesive tape.

3. Below-grade insulation must be in a waterproof, uncrushable sleeve/casing

§ 150.0(n)1A – Water-Heating, Individual Dwelling Units

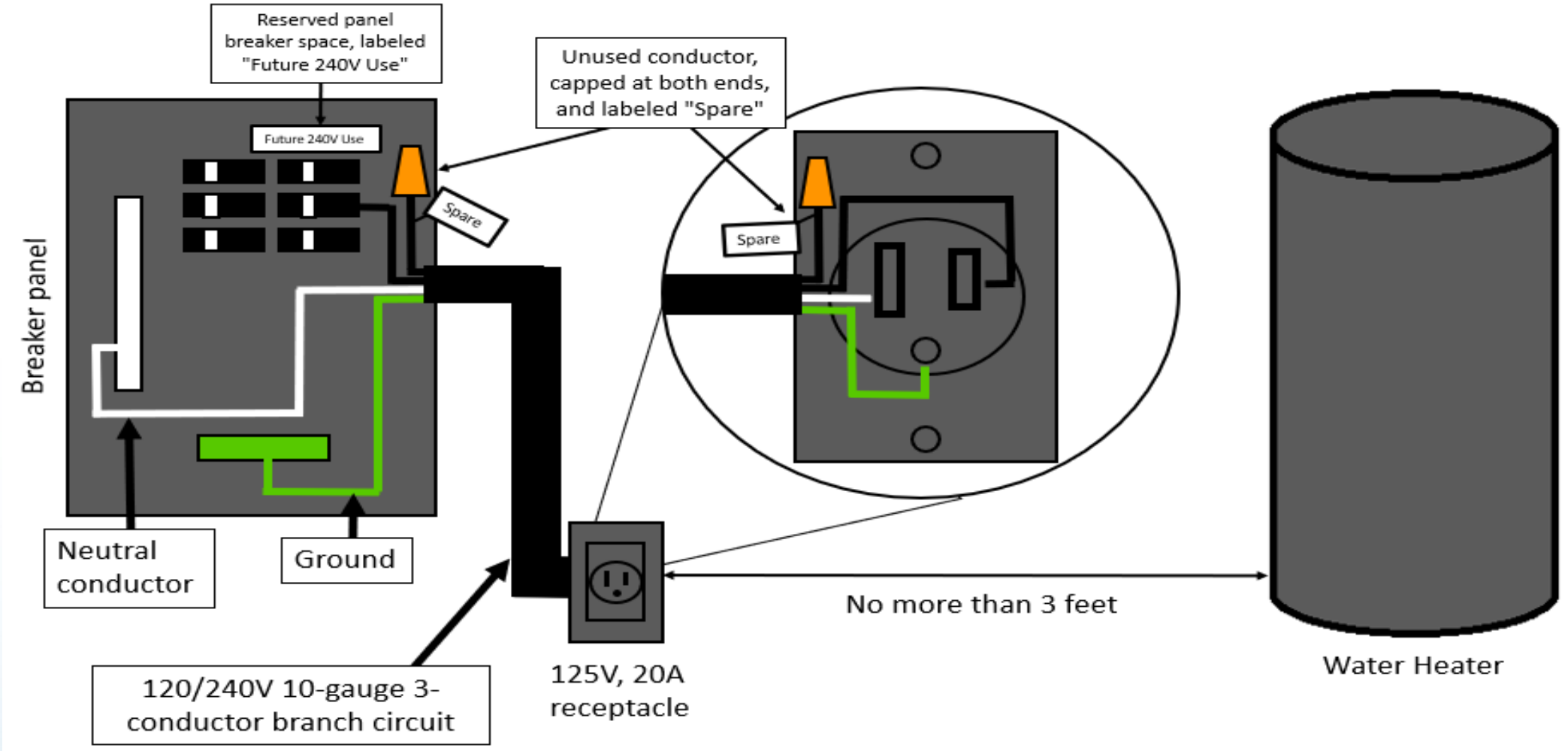
Systems with gas/propane water heaters serving individual dwelling units must have:

A. Dedicated 125V, 20A receptacle connected to the panel via 120/240V 3-conductor 10 AWG copper branch circuit, no more than 3 ft. from the water heater, unobstructed, AND

   i. Both ends of the unused conductor labeled "Spare" and electrically isolated

   ii. Reserved single breaker space, *next to* the breaker for the branch circuit, labeled "Future 240V use"

§ 150.0(n)1A – Diagram



§ 150.0(n)1B-D – Water-Heating, Individual Dwelling Units

B. Category III/IV, or Type B vent with straight pipe between the outside end and the space where the water heater is installed

C. Condensate drain no more than 2 inches above the base of the installed water heater, which allows natural draining without a pump

D. Gas supply line with a capacity of ≥ 200,000 BTU/hr

§ 150.0(n)2&3 – Water-Heating Mandatory Devices & Features

2. Recirculation loops serving multiple dwelling units must meet § 110.3(c)4.

3. Solar water-heating systems and collectors must be certified and rated by the Solar Rating and Certification Corporation (SRCC), IAPMO Research and Testing (IAPMO R&T), or an Executive Director-approved listing agency

§ 150.0(n)4 – Water-Heating Mandatory Devices & Features

Tankless water heaters rated > 6.8 kBTU/hr (2kW) must meet § 110.3(c)6:

- Must have isolation valves on both the cold and hot water pipes AND hose bibbs or other fittings to allow for maintenance flushing

§ 150.0(j) - Summary

- Insulate unfired storage tanks to R-12 (external), R-16 (internal, external label), or higher
- Insulate hot water pipes per CA Plumbing Code § 609.11
- Insulate these piping conditions to at least 1” thick or R-7.7:
  - First 5 ft. of cold water pipes from storage tank
  - All hot water piping ≥ ¾” and < 1” in diameter
  - All hot water piping < ¾” in diameter that is part of a domestic hot water recirculation system, between the heating source and kitchen fixtures/a tank, between tanks, or buried
- Insulate solar water heating collector loop piping per TABLE 120.3-A, or the equation
- Insulate and protect outdoor and below-grade pipes with proper covers/casings

§ 150.0(n) - Summary

- Gas/propane water heaters require:
  - Unobstructed 125/20A receptacle, connected to the panel with a 120/240V 10 AWG 3-conductor copper branch circuit
  - Category III/IV, or Type B vent with straight pipe
  - Condensate drain
  - Gas supply line ≥ 200,000 BTU/hr
- Recirculation loops serving multiple dwelling units must meet § 110.3(c)4
- Solar water-heating systems must be certified and rated by an approved agency
- Tankless water heaters > 6.8 kBTU/hr must meet § 110.3(c)6

§ 150.1

PERFORMANCE AND PRESCRIPTIVE; NEWLY- CONSTRUCTED LOW-RISE RESIDENTIAL BUILDINGS

§ 150.1(a)- Basic Requirements for Newly-Constructed Buildings

Basic Requirements – Newly-constructed low-rise residential buildings must meet:

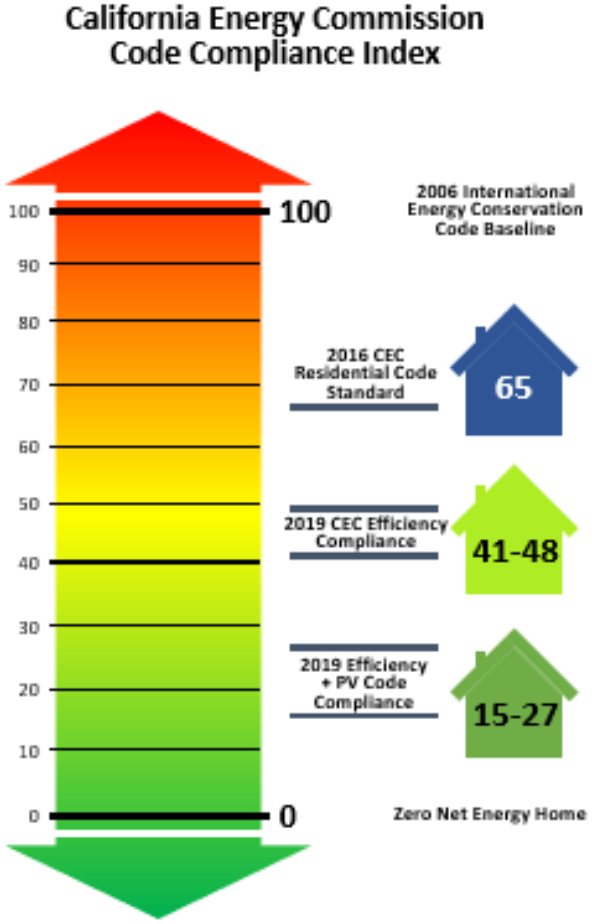
1. §§ 110.1 and 110.3
2. § 150.0
3. Performance or prescriptive standards

- EXCEPTION: If a subdivision/tract falls into multiple Climate Zones (CZs), all buildings therein can be designed for the CZ with 50% or more of the dwelling units

§150.1(b)1 - Performance Compliance (Newly-Constructed Buildings)

Energy budget in Energy Design Rating (EDR), based on Time-Dependent Value (TDV) energy.

- EDR score based on total estimated energy use
  - 100 represents a home built to 2006 IECC; 0 represents a zero net energy home



Energy Design Rating (EDR), as defined by the California Energy Commission, is an alternate way to express the energy performance of a building using a scoring system where 100 represents the energy performance of a Residential Energy Services (RESNET) reference home characterization of the 2006 IECC with California modeling assumptions. A score of 0 represents the energy performance of a building that combines high levels of energy efficiency with renewable generation to "zero out" its TDV energy.

§150.1(b)1 - Performance Compliance (Newly-Constructed Buildings), cont.

- Two types of EDR must be met individually
  - Efficiency EDR (EDR_{EE}): Includes energy savings for space heating, cooling, ventilation, water heating measures, plus limited credit for battery
  - Total EDR (EDR_{total}): EDR_{EE} minus compliance credit for PV, battery, and other demand flexibility measures
- CEC-approved community-shared solar/renewable electric generation/storage providing dedicated benefits to the permitted building can offset needed PV, but extra PV *cannot* make up for less efficient building systems!

Example: CF1R-PRF-01-E

CERTIFICATE OF COMPLIANCE — **CF1R-PRF-01E**

Project Name: Sample House — **Calculation Date/Time:** 2019-07-08T18:42:27-07:00 —

Calculation Description: Title 24 Analysis — **Input File Name:** Sample T24 2019 CBECC.ribd19

ENERGY DESIGN RATING

	Energy Design Ratings		Compliance Margins	
	Efficiency[1] (EDR)	Total[2] (EDR)	Efficiency[1] (EDR)	Total[2] (EDR)
Standard Design	45.9	24.7		
Proposed Design	45.4	24.2	0.5	0.5

RESULT: [3]: COMPLIES

[1] Efficiency measures include improvements like a better building envelope and more efficient equipment
[2] Total EDR includes efficiency, photovoltaics and batteries
[3] Building complies when all efficiency and total margins are greater than or equal to zero

- Standard Design PV Capacity: 2.68 kW
- PV System resized to 2.68 kWdc (a factor of 0.893) to achieve 'Standard Design PV' PV scaling

ENERGY USE SUMMARY

Energy Use (kTDV/ft^2-yr)	Standard Design	Proposed Design	Compliance Margin	Percent Improvement
Space Heating	18.54	17.25	1.29	7
Space Cooling	28.53	30.02	-1.49	-5.2
IAQ Ventilation	2.79	2.79	0	0
Water Heating	14.18	12.55	1.63	11.5
Self Utilization Credit	n/a	0	0	n/a
Compliance Energy Total	**64.04**	**62.61**	**1.43**	**2.2**

REQUIRED PV SYSTEMS

01	02	03	04	05	06	07	08	09	10	11
DC System Size (kWdc)	Exception	Module Type	Array Type	Power Electronics	CFI	Azimuth (deg)	Tilt Input	Array Angle (deg)	Tilt: (x in 12)	Inverter Eff. (%)
2.68	NA	Standard	Fixed (open rack)	none	true	n/a	n/a	n/a	n/a	96

Example: CF1R-PRF-01-E Features Tables

CERTIFICATE OF COMPLIANCE **CF1R-PRF-01E**

Project Name: Sample House **Calculation Date/Time:** 2019-07-08T18:42:27-07:00 **(Page 3 of 12)**

Calculation Description: Title 24 Analysis **Input File Name:** Sample T24 2019 CBECC.ribd19

REQUIRED SPECIAL FEATURES

The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.

- PV System: 2.68 kWdc
- Whole house fan
- Cool roof
- Insulation below roof deck
- Window overhangs and/or fins

HERS FEATURE SUMMARY

The following is a summary of the features that must be field-verified by a certified HERS Rater as a condition for meeting the modeled energy performance for this computer analysis. Additional detail is provided in the buildng tables below. Registered CF2Rs and CF3Rs are required to be completed in the HERS Registry

Building-level Verifications:
- Quality insulation installation (QII)
- IAQ mechanical ventilation
- Kitchen range hood
- Whole House Fan Airflow and Fan Efficacy

Cooling System Verifications:
- Minimum Airflow
- Verified EER
- Verified Refrigerant Charge
- Fan Efficacy Watts/CFM

Heating System Verifications:
- -- None --

HVAC Distribution System Verifications:
- Duct Sealing

Domestic Hot Water System Verifications:
- -- None --

Example: CF1R-PRF-01-E, cont.

WATER HEATING SYSTEMS							
01	02	03	04	05	06	07	08
Name	System Type	Distribution Type	Water Heater	Number of Heaters	Solar Fraction (%)	Compact Distribution	HERS Verification
DHW Sys 1	Domestic Hot Water (DHW)	Standard Distribution System	DHW Heater 1	1	0	None	n/a

WATER HEATERS											
01	02	03	04	05	06	07	08	09	10	11	12
Name	Heating Element Type	Tank Type	# Units	Tank Vol. (gal)	Energy Factor or Efficiency	Input Rating or Pilot	Tank Insulation R-value (Int/Ext)	Standby Loss or Recovery Eff.	1st Hr. Rating or Flow Rate	NEEA Heat Pump Brand or Model / Other	Tank Location or Ambient Condition
DHW Heater 1	Natural Gas	Consumer Instantaneous	1	0	0.95-UEF	200000-Btu/Hr	0	n/a	n/a	n/a	n/a

WATER HEATING - HERS VERIFICATION			
01	02	03	04
Name	Pipe Insulation	Parallel Piping	Compact Distribution
DHW Sys 1 - 1/1	Not Required	Not Required	Not Required

§ 150.1(b)2&3 - Performance Compliance

2. Energy Budgets for alterations and additions are based on TDV, ***not EDR***

3. Performance Compliance Demonstration

   A. Permit applications must include documents (§10-103(a)1&2) demonstrating that the design meets or beats the EDR_{EE} and EDR_{total} of the Standard Design for the CZ

      - EXCEPTION: Applicants may demonstrate compliance for any orientation of the same building model, if the documents show the model would comply in all 4 cardinal directions

§ 150.1(c)8- Prescriptive Compliance

Only *manually-controlled demand recirculation distribution systems (RA4.4.9)* allowed for individual dwelling units

Must meet A, B, or C:

§ 150.1(c)8Ai-iii – Prescriptive Compliance

A. Systems serving individual dwelling units (5 options):

Option	Type	Fuel	Gal	Max kBTU/hr	Additional Requirements
Ai	Tankless	Gas/propane	N/A	200	• Can be 1 or more
Aii	Storage	Gas/propane	≤ 55	75	• Windows U-factor ≤ 0.24, weighted average • Choose one: ○ Compact distribution (RA4.4.6) ○ Drain Water Heat Recovery (DWHR) (RA3.6.9)
Aiii	Storage	Gas/propane	> 55	75	

§ 150.1(c)8Aiv&v- Prescriptive Compliance

Option	Type	Additional Requirements

Aiv	Heat pump water heater (HPWH)	• Tank indoors
		• Choose one:
		  ○ Compact distribution (RA4.4.6) and DWHR (RA3.6.9)
		  ○ ***CZs 2-15:*** PV capacity 0.3 kWdc over §150.1(c)14 requirement
		  ○ ***CZs 1&16:*** PV capacity 1.1 kWdc over §150.1(c)14 requirement

Av	HPWH	• Tank indoors
		• NEEA Tier 3 or higher
		• ***CZs 1&16***, choose one:
		  ○ PV capacity 0.3 kWdc over §150.1(c)14 requirement
		  ○ Compact distribution (RA4.4.6)

Compact Hot Water Distribution System (CHWDS) Credits

- Water heaters too far from points of use (POU's) require more piping, wasting energy
- Credit is only available for single-family homes, or multifamily dwelling units with individual water heaters
  - Requires plan calculations
- *Expanded credit* available via HERS field verification (RA3.6.5) HERS rater must verify that the system has:
  - No hot water pipes > 1" diameter
  - No more than 8 ft., total, of pipes 1" in diameter
  - In 2- and 3-story buildings – no hot water pipes in the attic, unless the water heater is also in the attic
  - HERS-verified Demand Recirculation (RA4.4.17)

CHWDS Credit Calculation

- In the plans, *measure distances between the water heater* (red) *and the POU's* (blue) *in feet*
  - *Draw measurement points for second floor POU's as though they were on the first floor* (blue arrows); vertical pipes are ignored
- Apply the equations below
- *For credit, weighted distance < qualification distance*

Weighted distance = x × (ft. to furthest Master Bath fixture) + y × (ft. to furthest Kitchen fixture) + z × (ft. to furthest fixture)

Qualification distance = (a+b × [conditioned floor area, sqft])/(# of water heaters) *

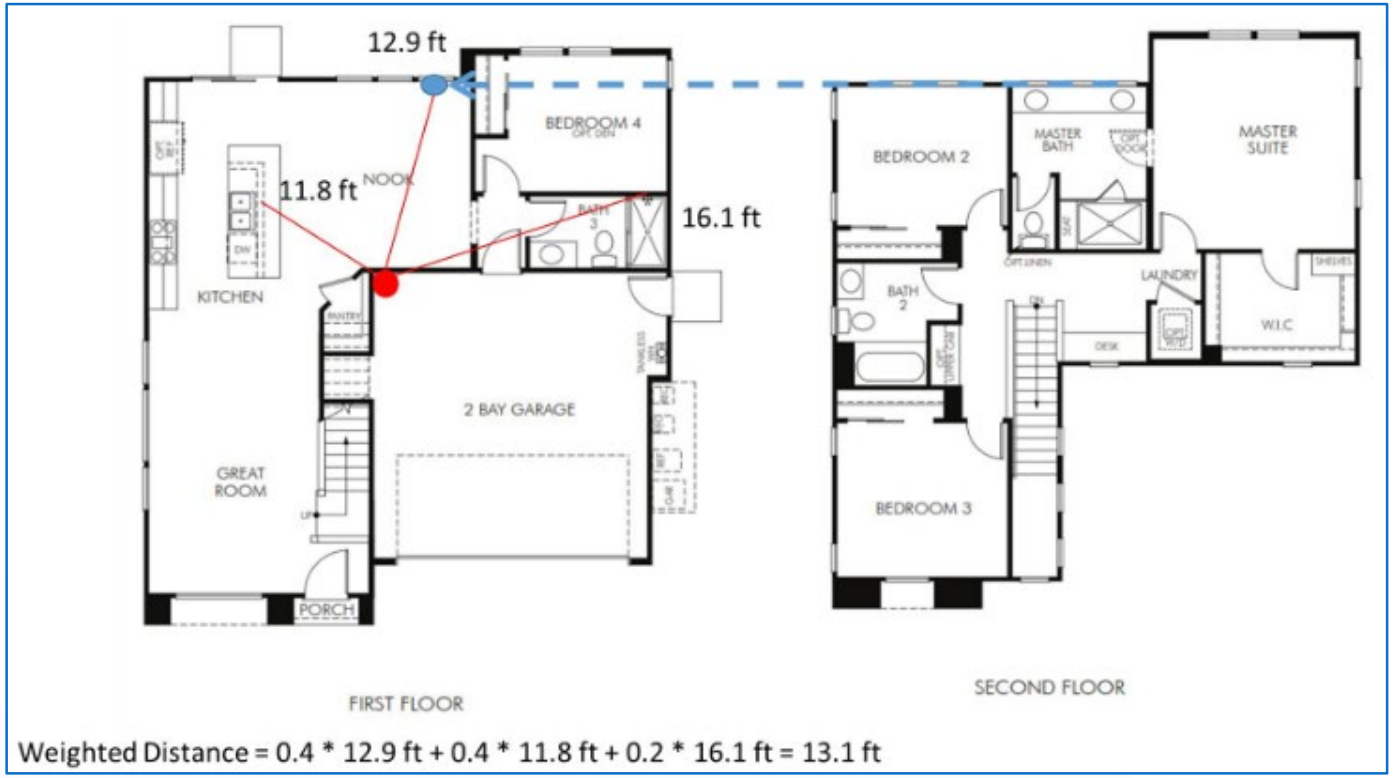
*See RA4.4.6 for details on coefficient values a, b, x, y, z

CHWDS Credit Calculation (Example A)

Source: 2019 Residential Compliance Manual

- Weighted distance = (0.4 x 28.9) + (0.4 x 31.1) + (0.2 x 34.3) = 30.9 ft
- Qualification distance = (15 + 0.0045 × 1814)/1 = 15 + 8.163 = *~23 ft*

CHWDS Credit Calculation (Example B)

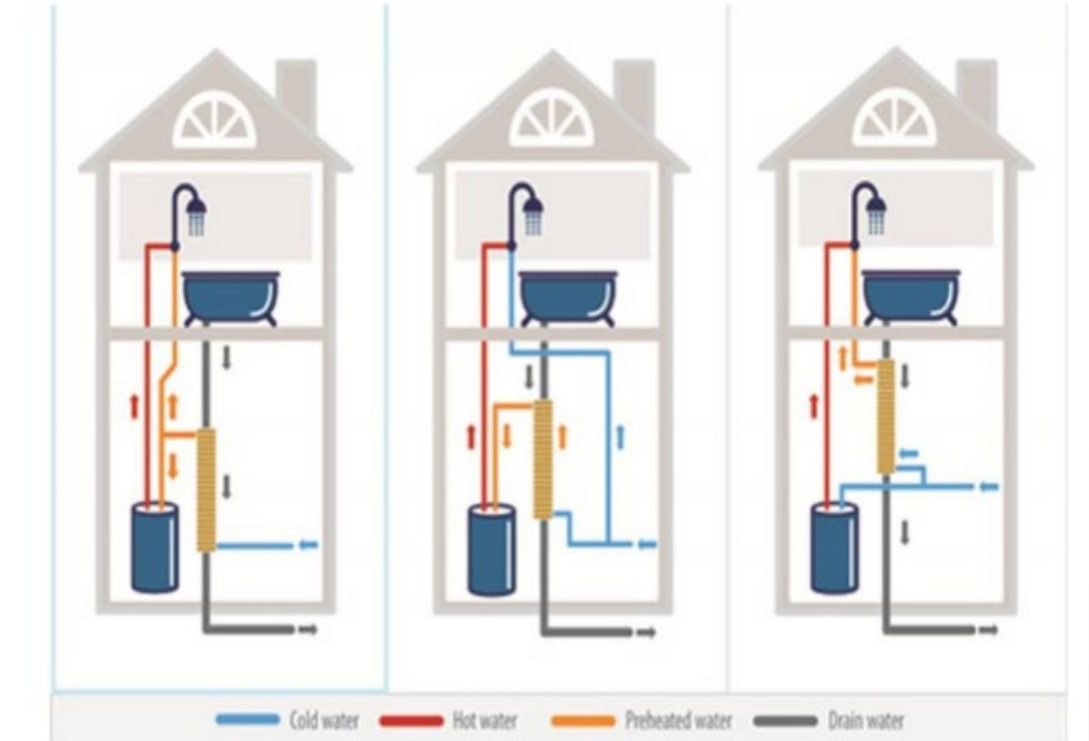


Source: 2019 Residential Compliance Manual

- Weighted distance = 13.1 ft
- Qualification distance = (15 + 0.0045 × 1814)/1 = 15 + 8.163 = *~23 ft*
  Same floor plan, but different water locations yield different results!

Drain Water Heat Recovery (DWHR) Credit

Figure 5-3: The Three Plumbing Configurations of DWHR Installation (From left to right: Equal Flow, Unequal Flow - Water Heater, Unequal Flow - Fixture)



Source: 2019 Residential Compliance Manual

- Saves energy by recycling heat from water flowing down the drain, via preheating water
- Three possible configurations – equal flow, unequal flow (water heater), and unequal flow (fixture)
  - *Equal flow* preheats water going to both the fixture and the water heater (maximizes benefit)
  - Unequal flow preheats water going to the fixture *or* water heater

DWHR Credit Requirements

- For credit, the DWHR unit must
  - Be certified to the CEC as…
    - Having a rated effectiveness ≥ 42%
    - Meeting the table at right
  - Meet the requirements on the next slide

Unit Type	Meet These Standards	Testing/Labeling per
Vertical	CSA B55.2	CSA 55.1 *or* IAPMO IGC 346-2017
Sloped	IAPMO PS 92	IAPMO IGC 346-2017

DWHR Credit Requirements, cont.

- DWHR unit must receive HERS verification that it/its…
  - Make, model, and effectiveness match the plans and documents
  - Model is certified to the CEC as qualified for credit*
  - Configuration and percentage of showers served match the compliance documents
  - At least, transfers heat from the master shower/showers above the first floor back to showers served by the water heater/the water heater itself
  - Is installed within 1° of the rated slope
  - Is installed per the CA Plumbing Code

*Download the Certified List

§ 150.1(c)8B – Prescriptive Compliance

B. Central water heating-systems serving multiple dwelling units must have:

   i. Gas or propane water heater*

   ii. Recirculation meeting § 110.3(c)2 & 4, with 2 or more separate loops serving separate dwelling units, able to auto-control the pump by hot water demand and return temperature

   - EXCEPTION: Buildings with 8 or fewer units can use 1 loop

*A HPWH was recently approved for this application! Download Blueprint #129 for details

§ 150.1(c)8B & C – Prescriptive Compliance

iii. Solar water heating meeting RA4, with these minimum solar savings fractions:

Option	CZs 1-9	CZs 10-16	Additional Requirements
Biiia	0.20	0.35	N/A
Biiib	0.15	0.30	DWHR (RA3.6.9)

C. Any water heating system the Executive Director determines uses no more energy than B

§ 150.1(b) & (c)8 - Summary

- Use performance or prescriptive paths of compliance
- Prescriptive
  - Individual dwelling units
    - Only Demand Recirculation Systems, with a manual on/off
    - Gas/propane water heaters (§ 150.1(c)8Ai-iii)
    - HPWH (§ 150.1(c)8Aiv-v)
  - Multiple dwelling units
    - Natural gas or propane water heating equipment
    - Recirculation with 2+ loops, with auto pump controls
    - Solar water heating system (field-verified DWHR option, by CZ)

§ 150.2

ADDITIONS AND ALTERATIONS – LOW-RISE RESIDENTIAL BUILDINGS

§150.2(a) – Additions

Additions to existing low-rise residential buildings must meet §110.0 - 110.9, §150.0(a) - (q), and prescriptive/performance requirements.

- *For water heating – §§ 110.1, 110.3, 150.0(j)&(n)*
- EXCEPTION 3: Existing inaccessible piping does not require insulation per §150.0(j)2Aiii.

§ 150.2(a)1D – Additions, Prescriptive Approach

When a second water heater is installed as part of the addition, install a water-heating system for a newly-constructed building (§150.1(c)8), or one declared by the Executive Director to be more efficient.

§ 150.2(a)2A – Performance Approach, Addition Alone

2. Performance calculations must meet §150.1(a)-(c), pursuant to A and B below.

   A. The addition complies if it, alone, meets the energy budgets in §150.1(b):

   $TDV_{proposed} \leq TDV_{standard}$

§ 150.2(a)2B – Performance Approach, E+A+A

B. E+A+A

Energy Use	Existing	Alterations	Additions
Standard design	Unaltered components to be kept	Altered components matching existing conditions, OR meeting §150.2(b)2, whichever is more efficient	Proposed features meeting §150.2(a)1*
Proposed design	Unaltered components to be kept	Altered components	Proposed features

*For water heating, same requirements as newly-constructed buildings – § 150.0(c)8

§ 150.2(b)1 – Alterations, Prescriptive Approach

Alterations to existing low-rise residential buildings, or in conjunction with a change into a low-rise residential occupancy must meet 1 and 2:

1. Prescriptive – The altered component and any newly-installed equipment serving the alteration must meet §110.0 - 110.9, §150.0(a) - (m), (o) - (q) *[for water heating, same as newly-constructed buildings - §§ 110.1, 110.3, 150.0(j)&(n)]*

§ 150.2(b)1H – Alterations, Prescriptive Requirements

H. Altered/replacement water-heating system must meet:

   i. Newly-installed piping must be insulated per § 150.0(j)2; existing accessible piping must be insulated per § 150.0(j)2Ai, iii, & iv

   ii. For individual units, only Demand Recirculation with manual on/off control (per RA4.4.9) is allowed

§ 150.2(b)1Hiii – Alterations, Prescriptive Requirements

iii. Choose one:

a. A natural gas/propane water heater

b. CZs 1-15: HPWH, tank indoors on an incompressible rigid surface insulated to R-value ≥ R-10, with an interface meeting § 110.12(a)

c. CZs 1-15: NEEA Tier 3 or higher HPWH, tank indoors

d. If no natural gas is connected to the existing water heater location, a consumer electric water heater

e. A water heater the Executive Director determines uses no more energy than iiia or iiid above

§ 150.2(b)2 – Alterations, Performance Approach

2. For altered components, and new equipment serving an alteration:
   A. Must meet all mandatory measures *[for water heating – §§ 110.1, 110.3, 150.0(j)&(n)]*
   B. Standard design must match existing conditions, or meet TABLE 150.2-C *[for water heating – § 150.2(b)1Hiii, same as prescriptive]*, whichever is more efficient; unaltered components must match existing conditions; if 3rd-party verification is required, all proposed components for credit must be verified
   C. Proposed design must be based on actual values of altered components

NOTES:

- Existing components replaced with new ones are considered altered, for the standard design altered component energy budget
- Standard design and proposed design must match in shape and orientation

§ 150.2(a) - Summary

- **Additions**
  - Prescriptive
    - When a second water heater is installed as part of the addition, install one meeting §150.1(c)8, or one approved by the Executive Director
  - Performance
    - Addition alone (§ 150.1(b))
    - E+A+A

§ 150.2(b)2 - Summary

- **Alterations**
  - Altered/replacement water-heater must have/be:
    - Piping insulated per § 150.0(j)
    - For individual dwelling units, Demand Recirculation with manual on/off control (per RA4.4.9) only
    - One of…
      - Natural gas/propane water heater
      - CZs 1-15: HPWH, tank indoors
      - If no natural gas at the water heater location, consumer electric OK
      - Water heater approved by the Executive Director

Forms & Enforcement

Compliance Documents Overview

Roles	Documents of Responsibility	What You Do
Designers/ Document Authors	• Plans and specs • CF1R	• Draw plans and specifications • Fill out CF1R forms
Plan Reviewer	• CF1R • Plans and specs	• Ensure the CF1R matches the plans and specs • Ensure the CF1R has no errors • Issue building permits as appropriate
Builder(s)/ General Contractor(s)	• All	• Submit CF1R and plans for plan check • Ensure contractors fill out CF2Rs appropriately • Provide copies of compliance documents to inspectors and owner(s) • Ensure HERS inspections are performed, as needed

Compliance Documents Overview, cont.

Roles	Documents of Responsibility	What You Do
Installers	• CF2R	• Fill out CF2Rs matching installed energy features; register with HERS registry, if needed • Make corrections to installations and CF2Rs, as needed
HERS Provider	• All	• Provide registry for compliance documents
HERS Rater(s)	• CF3R	• Verify features and send test results to HERS provider registry to generate registered CF3R • Confirm features being verified match the CF1R and CF2R • Confirm installer's results match HERS results
Building Inspector(s)	• All	• Verify all CF1Rs, CF2Rs, and CF3Rs are complete and registered, as needed • Verify building features

CF1R (Certificate of Compliance)

- Designers draw up the plans and fill out CF1R
  - Energy consultants or documentation authors can fill out these forms and/or suggest energy features
  - Consult with the building department about how to submit plans, specs, and CF1R with permit application; most require CF1R to be integrated into the plans
- Builders submit the CF1R for Plan Check
  - If a feature needs HERS testing, CF1R must be registered with an approved HERS provider registry
- Plan reviewers
  - If corrections are needed, they must be noted on the plans and CF1R and returned for corrections

CF1R-PRF-01-E Samples

CERTIFICATE OF COMPLIANCE — CF1R-PRF-01E (Page 1 of 8)

Project Name: Example ADU
Calculation Description: 1 Story Example Rev 3
Calculation Date/Time: 2020-09-16T16:03:08-07:00
Input File Name: ADUExample3AdditionAlone.ribd19

GENERAL INFORMATION					
01	Project Name	Example ADU			
02	Run Title	1 Story Example Rev 3			
03	Project Location	1516 Ninth St			
04	City	Sacramento, CA	05	Standards Version	2019
06	Zip code	95814	07	Software Version	CBECC-Res 2019.1.2
08	Climate Zone	12	09	Front Orientation (deg/ Cardinal)	0
10	Building Type	Single family	11	Number of Dwelling Units	1
12	Project Scope	AdditionOnly	13	Number of Bedrooms	4
14	Addition Cond. Floor Area (ft^2)	400	15	Number of Stories	1
16	Existing Cond. Floor Area (ft^2)	2100	17	Fenestration Average U-factor	0.3
18	Total Cond. Floor Area (ft^2)	2500	19	Glazing Percentage (%)	26.09%
20	ADU Bedroom Count	1	21	ADU Conditioned Floor Area	400
22	Is Natural Gas Available?	Yes			

Addition Alone Project Analysis Parameters					
01	02	03	04	05	06
Existing Area (excl. new addition) (ft2)	Addition Area (excl. existing) (ft2)	Total Area (ft2)	Existing Bedrooms	Addition Bedrooms	Total Bedrooms
2100	400	2500	3	1	4

COMPLIANCE RESULTS	
01	Building Complies with Computer Performance
02	This building incorporates features that require field testing and/or verification by a certified HERS rater under the supervision of a CEC-approved HERS provider.
03	This building incorporates one or more Special Features shown below

Registration Number: 420-P010116592A-000-000-0000000-0000 Registration Date/Time: 09/16/2020 16:05 HERS Provider: CHEERS

CA Building Energy Efficiency Standards - 2019 Residential Compliance Report Version: 2019.1.108 Schema Version: rev 20200101 Report Generated: 2020-09-16 16:03:19

CERTIFICATE OF COMPLIANCE — CF1R-PRF-01E (Page 2 of 8)

Project Name: Example ADU
Calculation Description: 1 Story Example Rev 3
Calculation Date/Time: 2020-09-16T16:03:08-07:00
Input File Name: ADUExample3AdditionAlone.ribd19

ENERGY USE SUMMARY

Energy Use (kTDV/ft^2-yr)	Standard Design	Proposed Design	Compliance Margin	Percent Improvement
Space Heating	31.63	40.73	-9.1	-28.8
Space Cooling	43.38	39.07	4.31	9.9
IAQ Ventilation	4.1	4.1	0	0
Water Heating	86.85	79.41	7.44	8.6
Self Utilization Credit	n/a	0	0	n/a
Compliance Energy Total	**165.96**	**163.31**	**2.65**	**1.6**

REQUIRED SPECIAL FEATURES

The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.

- Cool roof
- Insulation below roof deck
- Window overhangs and/or fins

HERS FEATURE SUMMARY

The following is a summary of the features that must be field-verified by a certified HERS Rater as a condition for meeting the modeled energy performance for this computer analysis. Additional detail is provided in the building tables below. Registered CF2Rs and CF3Rs are required to be completed in the HERS Registry

Building-level Verifications:
- Indoor air quality ventilation
- Kitchen range hood

Cooling System Verifications:
- -- None --

Heating System Verifications:
- -- None --

HVAC Distribution System Verifications:
- -- None --

Domestic Hot Water System Verifications:
- Recirculation, Demand Control Push Button

Registration Number: 420-P010116592A-000-000-0000000-0000 Registration Date/Time: 09/16/2020 16:05 HERS Provider: CHEERS

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CA Building Energy Efficiency Standards - 2019 Residential Compliance Report Version: 2019.1.108 Schema Version: rev 20200101 Report Generated: 2020-09-16 16:03:19

Project summary tables and information

Compliance results tables and features summaries are KEY

CF1R-PRF-01-E Samples, cont.

CERTIFICATE OF COMPLIANCE — CF1R-PRF-01E (Page 5 of 8)
Project Name: Example ADU — Calculation Date/Time: 2020-09-16T16:03:08-07:00
Calculation Description: 1 Story Example Rev 3 — Input File Name: ADUExample3AdditionAlone.ribd19

OPAQUE SURFACE CONSTRUCTIONS

01 Construction Name	02 Surface Type	03 Construction Type	04 Framing	05 Total Cavity R-value	06 Interior / Exterior Continuous R-value	07 U-factor	08 Assembly Layers
R15 Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O. C.	R-15	None / None	0.095	Inside Finish: Gypsum Board Cavity / Frame: R-15 / 2x4 Exterior Finish: 3 Coat Stucco
Tile High Performance	Attic Roofs	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-13	None / None	0.072	Roofing: 10 PSF (RoofTile) Tile Gap: present Roof Deck: Wood Siding/sheathing/decking Cavity / Frame: R-13.0 / 2x4 Around Roof Joists: R-0.0 insul.
R38 Ceiling below attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 Bottom Chord of Truss @ 24 in. O. C.	R-38	None / None	0.025	Over Ceiling Joists: R-28.9 insul. Cavity / Frame: R-9.1 / 2x4 Btm Chrd Inside Finish: Gypsum Board

BUILDING ENVELOPE - HERS VERIFICATION

01 Quality Insulation Installation (QII)	02 Quality Installation of Spray Foam Insulation	03 Building Envelope Air Leakage	04 CFM50
Not Required	Not Required	Not Required	n/a

WATER HEATING SYSTEMS

01 Name	02 System Type	03 Distribution Type	04 Water Heater Name (#)	05 Solar Heating System	06 Compact Distribution	07 HERS Verification
DHW System	Domestic Hot Water (DHW)	HERS Verified Demand Recirculation Manual Control	Small Instantaneous (1)	n/a	None	DHW System-hers-dhw

Registration Number: 420-P010116592A-000-000-0000000-0000 — Registration Date/Time: 09/16/2020 16:05 — HERS Provider: CHEERS
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Schema Version: rev 20200101

CERTIFICATE OF COMPLIANCE — CF1R-PRF-01E (Page 6 of 8)
Project Name: Example ADU — Calculation Date/Time: 2020-09-16T16:03:08-07:00
Calculation Description: 1 Story Example Rev 3 — Input File Name: ADUExample3AdditionAlone.ribd19

WATER HEATERS

01 Name	02 Heating Element Type	03 Tank Type	04 # Units	05 Tank Vol. (gal)	06 Energy Factor or Efficiency	07 Input Rating or Pilot	08 Tank Insulation R-value (Int/Ext)	09 Standby Loss or Recovery Eff.	10 1st Hr. Rating or Flow Rate	11 NEEA Heat Pump Brand or Model	12 Tank Location or Ambient Condition	13 Status	14 Verified Existing Condition
Small Instantaneous	Gas	Consumer Instantaneous	1	0	0.93-UEF	<= 200 kBtu/hr	0	n/a	n/a	n/a	n/a	New	n/a

WATER HEATING - HERS VERIFICATION

01 Name	02 Pipe Insulation	03 Parallel Piping	04 Compact Distribution	05 Compact Distribution Type	06 Recirculation Control	07 Central DHW Distribution	08 Shower Drain Water Heat Recovery
DHW System - 1/1	Not Required	Not Required	Not Required	None	Not Required	Required	Not Required

SPACE CONDITIONING SYSTEMS

01 Name	02 System Type	03 Heating Unit Name	04 Cooling Unit Name	05 Fan Name	06 Distribution Name	07 Required Thermostat Type	08 Status	09 Verified Existing Condition	10 Heating Equipment Count	11 Cooling Equipment Count
HVAC System 1	Heat pump heating cooling	Minisplit	Minisplit			Setback	New	NA	1	1

HVAC - HEAT PUMPS

01 Name	02 System Type	03 Number of Units	04 Heating	05 Heating	06 Heating	07 Cooling	08 Cooling	09 Zonally Controlled	10 Compressor Type	11 HERS Verification
			HSPF/COP	Cap 47	Cap 17	SEER	EER			
Minisplit	Ductless MiniSplit HP	1	8.2	36000	24000	14	11.7	Not Zonal	Single Speed	Minisplit-hers-htpump

Registration Number: 420-P010116592A-000-000-0000000-0000 — Registration Date/Time: 09/16/2020 16:05 — HERS Provider: CHEERS
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CA Building Energy Efficiency Standards - 2019 Residential Compliance — Report Version: 2019.1.108 — Report Generated: 2020-09-16 16:03:19
Schema Version: rev 20200101

- Specific tables for water heater information
- Note the HERS registry water mark, and registration number in the lower left corner

Certificate of Compliance (CF1R) Forms for Water Heating

	New Construction	Additions	Alterations
Prescriptive	• NCB-01-E	• ADD-01-E (≤ 1,000 sq. ft) • ADD-02-E	• ALT-01-E • ALT-05-E
Performance	• PRF-01-E*		

* Performance approach CF1R's are generated by approved compliance software

CF2R (Certificate of Installation)

- Builders/contractors
  - Stick to the plans & specs approved by the building department!
  - Any changes must be approved by the building deparment (make sure construction is still complies with code)
    - If needed, the builder/designer must update the CF1R and plans and resubmit
- Installers must fill out and sign CF2Rs when installing regulated energy features
  - Post or provide them onsite for final inspection, or provide a Project Status Report (PSR)
  - If a feature needs HERS testing, all CF2Rs must be registered with an approved HERS provider registry

Certificate of Installation (CF2R) Forms for Water Heating

Non-HERS

- CF2R
  - ADD-02-E: Additions, Prescriptive
  - ALT-05-E: Alterations
  - PLB-01-E: Multifamily Central Hot Water Distribution*
  - PLB-02-E: Single Dwelling, Hot Water Distribution*

HERS

- CF2R
  - PLB-21-H: Multifamily Central Hot Water Distribution*
  - PLB-22-H: Single Dwelling, Hot Water Distribution*

* Two versions available; one version is for NEEA water heaters

Sample CF2R-PLB-22-H

CERTIFICATE OF INSTALLATION					CF2R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution					(Page 1 of 5)
Project Name:	ADU Example HERS D-circ	**Enforcement Agency:**	Sacramento, City of	**Permit Number:**	permit20
Dwelling Address:	1516 Ninth St	**City:**	Sacramento, CA	**Zip Code:**	95814

A. Design HERS Verified Dwelling Unit Water Heating Systems Information
This table reports the water heating system features that were specified on the registered CF1R compliance document for this project.

01	02	03	04	05	06	07	08	09	10	11	12
Dwelling Unit Name	Water Heating System ID or Name	Water Heating System Type	Water-Heater Type	# of Water Heaters in System	Fuel Type	Rated Input Type	Rated Input Value	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type	Compact Distrib.	Drain Water Heat Recovery
Single Family Dwelling	DHW System	Domestic Hot Water (DHW)	Consumer Instantaneous	1	Natural Gas	Btu/Hr	200000.00	NA	HERS Verified Demand Recirculation Manual Control	None	None

B. Installed HERS Verified Dwelling Unit Water Heating Systems Information
This table reports the water heating system features that were installed in this project.

01	02	03	04	05	06	07	08	09	10	11	12
Dwelling Unit Name	Water Heating System ID or Name	Water Heating System Type	Water-Heater Type	# of Water Heaters in System	Fuel Type	Rated Input Type	Rated Input Value	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type	Compact Distrib.	Drain Water Heat Recovery
Single Family Dwelling	DHW System	Domestic Hot Water (DHW)	Consumer Instantaneous	1	Natural Gas	Btu/Hr	200000	NA	HERS Verified Demand Recirculation Manual Control	None	None

C. Design HERS Verified Dwelling Unit Water Heating Efficiency Information
This table reports the water heater(s) efficiency features specified on the registered CF1R compliance document for this project.

01	02	03	04	05	06	07
Water Heating System ID or Name	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Water Heater Storage Volume (gal)	Tank Location
DHW System	UEF	0.93	n/a	0	0.00	n/a

TABLE A to TABLE C: Water heater information

Sample CF2R-PLB-22-H, TABLE D & TABLE E

D. Installed HERS Verified Dwelling Unit Water Heating Efficiency Information
This table reports the water heating system features that were installed in this project.

01	02	03	04	05	06	07
Water Heating System ID or Name	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Water Heater Storage Volume (gal)	Tank Location
DHW System	UEF	0.93	n/a	0	0	n/a

E. Installed Water Heater Manufacturer Information

01	02	03
Water Heating System ID or Name	Manufacturer	Model Number
DHW System	Wong	MN9393i

TABLE D & TABLE E: Water heater information (continued)

Sample CF2R-PLB-22-H, TABLE F to TABLE L

F. Mandatory Measures For All Domestic Hot Water Distribution Systems	
04	For Gas or Propane Water Heaters: Ensure the following are installed (Section 150.0(n)) 1. A dedicated 120V, 20A electrical receptacle connected to the electrical panel with a 120/240V 3 conductor, 10AWG copper branch circuit, within 3 feet from the water heater and accessible with no obstructions 1. The conductor shall be labeled with the word "Spare" on both ends; and 2. A reserved single pole circuit breaker space next to the circuit breaker next to the branch circuit labeled "Future" 240V shall be provided. 2. A Category III or IV vent, or a Type B vent with straight pipe between outside and water heater 3. A condensate drain no more than 2 inches higher than the base on water heater for natural draining 4. A gas supply line with capacity of at least 200,000 Btu/Hr
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

G. HERS Verified Compact Hot Water Distribution Expanded Credit (CHWDS-H-EX) RA3.6.5
This section does not apply to this project.

H. Compact Hot Water Distribution (CHWDS) RA4.4.6
This section does not apply to this project.

I. HERS-Verified Drain Water Heat Recovery System (DWHR-H) (RA3.6.9)
This section does not apply to this project.

J. HERS-Verified Pipe Insulation Credit Requirements (PIC-H) (RA3.6.3)
This section does not apply to this project.

K. HERS-Verified Parallel Piping Requirements (PP-H) (RA3.6.4)
This section does not apply to this project.

L. Parallel Piping Requirements (PP) (RA4.4.4)
This section does not apply to this project.

Registration Number: 420-P010116592A-000-001-B22001A-0000 Registration Date/Time: 2020-09-16 16:06:14 HERS Provider: CHEERS

NOTICE: This document has been generated by ConSol Home Energy Efficiency Rating System Services, Inc. (CHEERS) using information uploaded by third parties not affiliated with or related to CHEERS. Therefore, CHEERS is not responsible for, and cannot guarantee, the accuracy or completeness of the information contained in this document.

CA Building Energy Efficiency Standards - 2019 Residential Compliance Report Version: 2019.1.003 Report Generated: 2020-09-16 16:08:29

Schema Version: rev 20191201

- TABLE F to TABLE L: Requirements and Available Compliance Credits
- Note:
  - HERS provider registry watermark and registration number (lower left corner)
  - Note TABLES collapse and say "Does not apply" when not needed

Sample CF2R-PLB-22-H, TABLE M to TABLE Q

M. Point of Use Requirements (POU) (RA4.4.5)
This section does not apply to this project.

N. Mandatory Requirements For All Recirculation Systems (RA4.4.7)
This section does not apply to this project.

O. Recirculation Non-Demand Controls Requirements (R-ND) (RA4.4.8)
This section does not apply to this project.

P. Demand Recirculation Manual Control (R-DRmc) (RA4.4.9)/ Sensor Control Requirements (RDRsc) (RA4.4.10)
This section does not apply to this project.

Q. HERS-Verified Demand Recirculation Manual Control (RDRmc-H) (RA3.6.6)/ Sensor Control (RDRsc - H) (RA3.6.7)Requirements
This section does not apply to this project.

- TABLE M to TABLE Q: Requirements and Available Compliance Credits (continued)
- Note:
  - HERS provider registry watermark and registration number (lower left corner)
  - Note TABLES collapse and say "Does not apply" when not needed

CF3R (Certificate of Verification)

- HERS Raters
  - Verify that CF2Rs and CF1R are registered
  - Features must meet the requirements listed on the CF1R
  - Installer test results on CF2R-H forms must comply with the CF1R and plan requirements
  - Test any features that need it (see CF1R)
    - Passing features get a registered CF3R; posted onsite for final inspection/put onto the PSR
    - Failing ones must be corrected and retested
    - Either way, the result goes into the HERS registry
- ***ALL newly-constructed homes need HERS testing***
- Performance credits *[for water heating: DWHR, compact distribution, pipe insulation]*

Certificate of Verification (CF3R) Forms for Water Heating

- All HERS measures!
- Completed and signed by the HERS Rater
- CF3R
  - EXC-20-E: Existing Conditions, Alterations
  - PLB-21-E*: Multifamily Central Hot Water Distribution
  - PLB-22-E*: Single Dwelling, Central Hot Water Distribution

* Two versions available; one version is for NEEA water heaters

Sample CF3R-PLB-22-H

Similar to the CF2R-PLB-22, but these are available only from HERS Raters and should ALWAYS have a HERS watermark!

CERTIFICATE OF VERIFICATION					CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution					(Page 1 of 6)
Project Name:	ADU Example HERS D-circ	**Enforcement Agency:**	Sacramento, City of	**Permit Number:**	permit20
Dwelling Address:	1516 Ninth St	**City:**	Sacramento, CA	**Zip Code:**	95814

A. Design HERS Verified Dwelling Unit Water Heating Systems Information
This table reports the water heating system features that were specified on the registered CF1R compliance document for this project.

01	02	03	04	05	06	07	08	09	10	11	12
Dwelling Unit Name	Water Heating System ID or Name	Water Heating System Type	Water-Heater Type	# of Water Heaters in System	Fuel Type	Rated Input Type	Rated Input Value	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type	Compact Distrib.	Drain Water Heat Recovery
Single Family Dwelling	DHW System	Domestic Hot Water (DHW)	Consumer Instantaneous	1	Natural Gas	Btu/Hr	200000.00	NA	HERS Verified Demand Recirculation Manual Control	None	None

B. Installed HERS Verified Dwelling Unit Water Heating Systems Information
This table reports the water heating system features that were installed in this project.

01	02	03	04	05	06	07	08	09	10	11	12
Dwelling Unit Name	Water Heating System ID or Name	Water Heating System Type	Water-Heater Type	# of Water Heaters in System	Fuel Type	Rated Input Type	Rated Input Value	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type	Compact Distrib.	Drain Water Heat Recovery
Single Family Dwelling	DHW System	Domestic Hot Water (DHW)	Consumer Instantaneous	1	Natural Gas	Btu/Hr	200000	NA	HERS Verified Demand Recirculation Manual Control	None	None

Sample CF3R-PLB-22-H, TABLE C to TABLE E

CERTIFICATE OF VERIFICATION	CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution	(Page 2 of 6)

C. Design HERS Verified Dwelling Unit Water Heating Efficiency Information

This table reports the water heater(s) efficiency features specified on the registered CF1R compliance document for this project.

01	02	03	04	05	06	07
Water Heating System ID or Name	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Water Heater Storage Volume (gal)	Tank Location
DHW System	UEF	0.93	n/a	0	0.00	n/a

D. Installed HERS Verified Dwelling Unit Water Heating Efficiency Information

This table reports the water heating system features that were installed in this project.

01	02	03	04	05	06	07
Water Heating System ID or Name	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Water Heater Storage Volume (gal)	Tank Location
DHW System	UEF	0.93	n/a	4	0	n/a

08	Compliance Statement	System complies

E. Installed Water Heater Manufacturer Information

01	02	03
Water Heating System ID or Name	Manufacturer	Model Number
DHW System	Wong	MN9393i

Sample CF3R-PLB-22-H, TABLE F

F. Mandatory Measures For All Domestic Hot Water Distribution Systems			
03	The following pipes are insulated, to the thicknesses required by Table 120.3A, except for those sections of pipe that are subject to one of the exceptions below: All domestic hot water pipes shall be insulated as specified in Section 609.11 of the California Plumbing Code. In addition, the following piping conditions shall have a minimum insulation wall thickness of 1 inch or a minimum insulation R-value of 7.7 (RA4.4.1) • The first 5 feet (1.5 meters) of cold water pipes from the storage tank. • All piping with a nominal diameter of 3/4 inch (19 millimeter) and less than 1 inch.. • All hot water pipes from the heating source to the kitchen fixtures. • All underground piping. • Insulation buried below grade must be installed in a waterproof and non-crushable casing or sleeve. • Piping from the heating source to storage tank or between tanks. • Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing. Insulation shall butt securely against all framing members. • Piping installed in interior or exterior walls that is surrounded on all sides by at least 1 inch (2.5 cm) of insulation. • Piping installed in crawl space with a minimum of 1 inch (2.5 cm) of crawl space insulation above and below. • Piping installed in attics with a minimum of 4 inches (10 cm) of attic insulation on top • Piping insulation shall fit tightly and all elbows and tees shall be fully insulated.		
04	For Gas or Propane Water Heaters: Ensure the following are installed (Section 150.0(n)) 1. A dedicated 120V, 20A electrical receptacle connected to the electrical panel with a 120/240V 3 conductor, 10AWG copper branch circuit, within 3 feet from the water heater and accessible with no obstructions 1. The conductor shall be labeled with the word "Spare" on both ends; and 2. A reserved single pole circuit breaker space next to the circuit breaker next to the branch circuit labeled "Future" 240V shall be provided. 2. A Category III or IV vent, or a Type B vent with straight pipe between outside and water heater 3. A condensate drain no more than 2 inches higher than the base on water heater for natural draining 4. A gas supply line with capacity of at least 200,000 Btu/Hr		
05	Verification Status:	☒	Pass - all applicable requirements are met.
		☐	Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below
		☐	n/a
06			
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.			

TABLE F: Requirements and Available Compliance Credits

Sample CF3R-PLB-22-H, TABLE G to TABLE Q, TABLE R

G. HERS Verified Compact Hot Water Distribution Expanded Credit (CHWDS-H-EX) RA3.6.5
This section does not apply to this project.

H. Compact Hot Water Distribution (CHWDS) RA4.4.6
This section does not apply to this project.

I. HERS-Verified Drain Water Heat Recovery System (DWHR-H)
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J. HERS-Verified Pipe Insulation Credit Requirements (PIC-H) (RA3.6.3)
This section does not apply to this project.

K. HERS-Verified Parallel Piping Requirements (PP-H) (RA3.6.4)
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This section does not apply to this project.

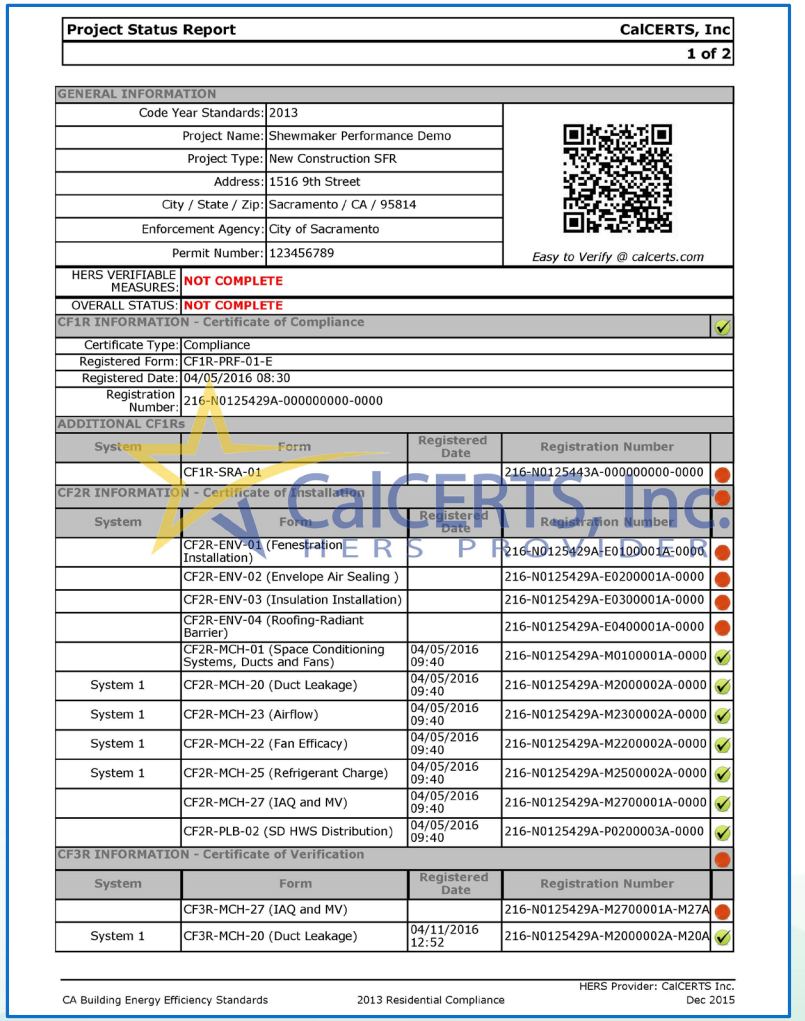
O. Recirculation Non-Demand Controls Requirements (R-ND) (RA4.4.8)
This section does not apply to this project.

R. Determination of HERS Verification Compliance	
01	Complies: All specified verification protocol requirements on this document are met.

- TABLE G to TABLE Q: Requirements and Available Compliance Credits (continued)
- TABLE R: HERS Compliance Result

A Handy Tool – The PSR

- Available through your HERS Provider registry
- Compiles and summarizes the progress of your compliance documentation
- Some jurisdictions may accept these during inspections



Project Status Report — **CalCERTS, Inc** — **1 of 2**

GENERAL INFORMATION

Code Year Standards:	2013
Project Name:	Shewmaker Performance Demo
Project Type:	New Construction SFR
Address:	1516 9th Street
City / State / Zip:	Sacramento / CA / 95814
Enforcement Agency:	City of Sacramento
Permit Number:	123456789

Easy to Verify @ calcerts.com

HERS VERIFIABLE MEASURES:	NOT COMPLETE
OVERALL STATUS:	NOT COMPLETE

CF1R INFORMATION - Certificate of Compliance ✓

Certificate Type:	Compliance
Registered Form:	CF1R-PRF-01-E
Registered Date:	04/05/2016 08:30
Registration Number:	216-N0125429A-000000000-0000

ADDITIONAL CF1Rs

System	Form	Registered Date	Registration Number	
	CF1R-SRA-01		216-N0125443A-000000000-0000	●

CF2R INFORMATION - Certificate of Installation ●

System	Form	Registered Date	Registration Number	
	CF2R-ENV-01 (Fenestration Installation)		216-N0125429A-E0100001A-0000	●
	CF2R-ENV-02 (Envelope Air Sealing)		216-N0125429A-E0200001A-0000	●
	CF2R-ENV-03 (Insulation Installation)		216-N0125429A-E0300001A-0000	●
	CF2R-ENV-04 (Roofing-Radiant Barrier)		216-N0125429A-E0400001A-0000	●
	CF2R-MCH-01 (Space Conditioning Systems, Ducts and Fans)	04/05/2016 09:40	216-N0125429A-M0100001A-0000	✓
System 1	CF2R-MCH-20 (Duct Leakage)	04/05/2016 09:40	216-N0125429A-M2000002A-0000	✓
System 1	CF2R-MCH-23 (Airflow)	04/05/2016 09:40	216-N0125429A-M2300002A-0000	✓
System 1	CF2R-MCH-22 (Fan Efficacy)	04/05/2016 09:40	216-N0125429A-M2200002A-0000	✓
System 1	CF2R-MCH-25 (Refrigerant Charge)	04/05/2016 09:40	216-N0125429A-M2500002A-0000	✓
	CF2R-MCH-27 (IAQ and MV)	04/05/2016 09:40	216-N0125429A-M2700001A-0000	✓
	CF2R-PLB-02 (SD HWS Distribution)	04/05/2016 09:40	216-N0125429A-P0200003A-0000	✓

CF3R INFORMATION - Certificate of Verification ●

System	Form	Registered Date	Registration Number	
	CF3R-MCH-27 (IAQ and MV)		216-N0125429A-M2700001A-M27A	●
System 1	CF3R-MCH-20 (Duct Leakage)	04/11/2016 12:52	216-N0125429A-M2000002A-M20A	✓

CA Building Energy Efficiency Standards — 2013 Residential Compliance — HERS Provider: CalCERTS Inc. Dec 2015

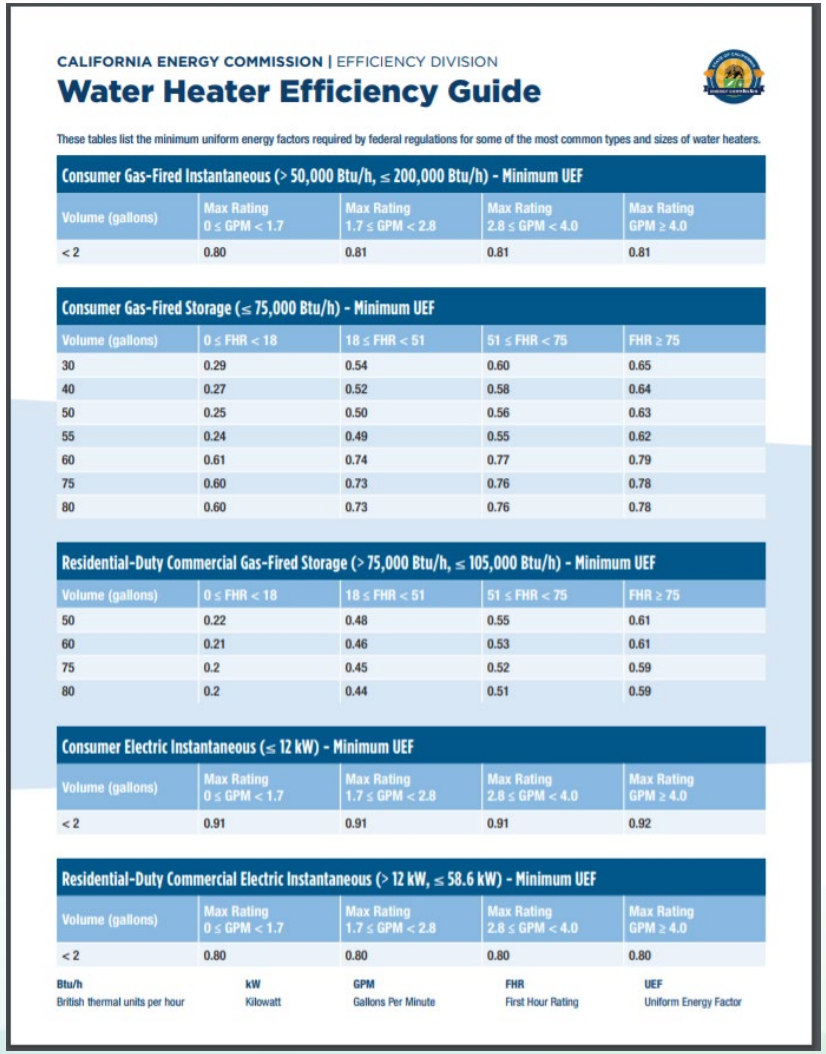
Resources

Online Resource Center (ORC)

Visit our Online Resources Center

Water Heater Efficiency Guide

[Download the Water Heater Efficiency Guide]



CALIFORNIA ENERGY COMMISSION | EFFICIENCY DIVISION

Water Heater Efficiency Guide

These tables list the minimum uniform energy factors required by federal regulations for some of the most common types and sizes of water heaters.

Consumer Gas-Fired Instantaneous (> 50,000 Btu/h, ≤ 200,000 Btu/h) - Minimum UEF

Volume (gallons)	Max Rating 0 ≤ GPM < 1.7	Max Rating 1.7 ≤ GPM < 2.8	Max Rating 2.8 ≤ GPM < 4.0	Max Rating GPM ≥ 4.0
< 2	0.80	0.81	0.81	0.81

Consumer Gas-Fired Storage (≤ 75,000 Btu/h) - Minimum UEF

Volume (gallons)	0 ≤ FHR < 18	18 ≤ FHR < 51	51 ≤ FHR < 75	FHR ≥ 75
30	0.29	0.54	0.60	0.65
40	0.27	0.52	0.58	0.64
50	0.25	0.50	0.56	0.63
55	0.24	0.49	0.55	0.62
60	0.61	0.74	0.77	0.79
75	0.60	0.73	0.76	0.78
80	0.60	0.73	0.76	0.78

Residential-Duty Commercial Gas-Fired Storage (> 75,000 Btu/h, ≤ 105,000 Btu/h) - Minimum UEF

Volume (gallons)	0 ≤ FHR < 18	18 ≤ FHR < 51	51 ≤ FHR < 75	FHR ≥ 75
50	0.22	0.48	0.55	0.61
60	0.21	0.46	0.53	0.61
75	0.2	0.45	0.52	0.59
80	0.2	0.44	0.51	0.59

Consumer Electric Instantaneous (≤ 12 kW) - Minimum UEF

Volume (gallons)	Max Rating 0 ≤ GPM < 1.7	Max Rating 1.7 ≤ GPM < 2.8	Max Rating 2.8 ≤ GPM < 4.0	Max Rating GPM ≥ 4.0
< 2	0.91	0.91	0.91	0.92

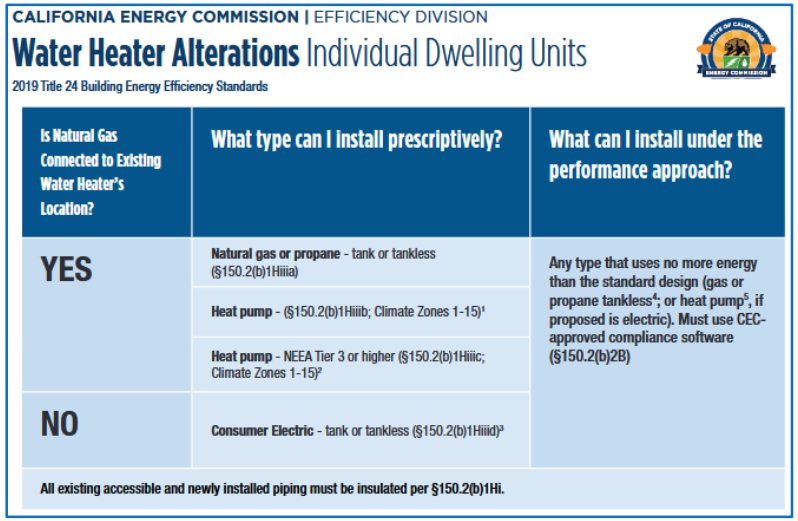
Residential-Duty Commercial Electric Instantaneous (> 12 kW, ≤ 58.6 kW) - Minimum UEF

Volume (gallons)	Max Rating 0 ≤ GPM < 1.7	Max Rating 1.7 ≤ GPM < 2.8	Max Rating 2.8 ≤ GPM < 4.0	Max Rating GPM ≥ 4.0
< 2	0.80	0.80	0.80	0.80

Btu/h — British thermal units per hour
kW — Kilowatt
GPM — Gallons Per Minute
FHR — First Hour Rating
UEF — Uniform Energy Factor

Water Heater Alterations Counter Card

Download the Water Heater Alterations Counter Card - Perfect for permit technicians!



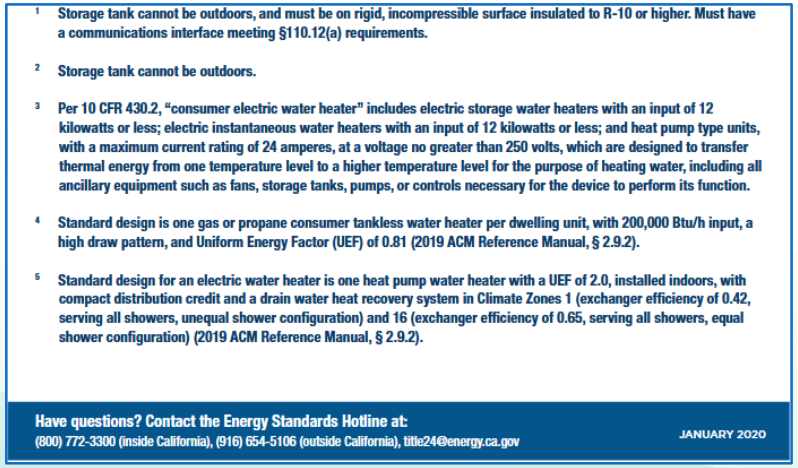
CALIFORNIA ENERGY COMMISSION | EFFICIENCY DIVISION

Water Heater Alterations Individual Dwelling Units

2019 Title 24 Building Energy Efficiency Standards

Is Natural Gas Connected to Existing Water Heater's Location?	What type can I install prescriptively?	What can I install under the performance approach?
YES	**Natural gas or propane** - tank or tankless (§150.2(b)1Hiiia)	Any type that uses no more energy than the standard design (gas or propane tankless[4]; or heat pump[5], if proposed is electric). Must use CEC-approved compliance software (§150.2(b)2B)
	Heat pump - (§150.2(b)1Hiiib; Climate Zones 1-15)[1]	
	Heat pump - NEEA Tier 3 or higher (§150.2(b)1Hiiic; Climate Zones 1-15)[2]	
NO	**Consumer Electric** - tank or tankless (§150.2(b)1Hiiid)[3]	

All existing accessible and newly installed piping must be insulated per §150.2(b)1Hi.



1 Storage tank cannot be outdoors, and must be on rigid, incompressible surface insulated to R-10 or higher. Must have a communications interface meeting §110.12(a) requirements.

2 Storage tank cannot be outdoors.

3 Per 10 CFR 430.2, "consumer electric water heater" includes electric storage water heaters with an input of 12 kilowatts or less; electric instantaneous water heaters with an input of 12 kilowatts or less; and heat pump type units, with a maximum current rating of 24 amperes, at a voltage no greater than 250 volts, which are designed to transfer thermal energy from one temperature level to a higher temperature level for the purpose of heating water, including all ancillary equipment such as fans, storage tanks, pumps, or controls necessary for the device to perform its function.

4 Standard design is one gas or propane consumer tankless water heater per dwelling unit, with 200,000 Btu/h input, a high draw pattern, and Uniform Energy Factor (UEF) of 0.81 (2019 ACM Reference Manual, § 2.9.2).

5 Standard design for an electric water heater is one heat pump water heater with a UEF of 2.0, installed indoors, with compact distribution credit and a drain water heat recovery system in Climate Zones 1 (exchanger efficiency of 0.42, serving all showers, unequal shower configuration) and 16 (exchanger efficiency of 0.65, serving all showers, equal shower configuration) (2019 ACM Reference Manual, § 2.9.2).

Have questions? Contact the Energy Standards Hotline at:
(800) 772-3300 (inside California), (916) 654-5106 (outside California), title24@energy.ca.gov

JANUARY 2020

Blueprint

- Quarterly newsletter
- Clarifications on frequently asked questions
- Subscribe to the Blueprint

Issue 131 | July - September 2020

BLUEPRINT

CALIFORNIA ENERGY COMMISSION

EFFICIENCY DIVISION

IN THIS ISSUE

- Nonresidential Mechanical Acceptance Testing
- New 2019 Energy Code Resources Available on the ORC
  - 2019 HERS Reference Card
  - 2019 ATTCP Reference Card
  - 2019 Water Heater Guides
  - 2019 Energy Code Envelope Air Sealing Fact Sheet
  - 2019 Energy Code Presentations
- Energy Code Dynamic Forms Relocated
- Q&A
  - Nonresidential Indoor Lighting
  - Nonresidential Outdoor Lighting Alterations
  - Nonresidential Curtain Walls
  - High-Rise Residential and Low-Rise Residential Kitchen Range Hoods
  - Indoor Air Quality
  - Residential ADUs
  - Residential Single-Width Headers

Nonresidential Mechanical Acceptance Testing

For several codes cycles, the Building Energy Efficiency Standards (Energy Code) have included requirements for acceptance testing of mechanical systems in nonresidential buildings by a certified acceptance test technician (ATT). Until now, the minimum thresholds of 300 certified ATTs and ATT certification training available to all qualified technicians had not been met. These prerequisites for mandating compliance with the mechanical ATT regulations are now fulfilled.

As a result, California Energy Commission (CEC) staff is preparing a recommendation to the CEC to move forward with implementation of the mechanical ATT mandate. The CEC is expected to adopt staff's recommendations at its business meeting in January 2021. After adoption, a phased plan for enforcement will be announced. All technicians performing mechanical acceptance tests on nonresidential building projects must then be trained and certified by an approved Acceptance Test Technician Certification Provider (ATTCP). The certified ATT's will be held to quality assurance standards, with penalties for nonconformance.

Staff is seeking input from all stakeholders by encouraging participation in the upcoming workshop and public comment period, or by contacting staff directly. For more information on the ATTCP program and to participate in developing the implementation plan, please refer to the **Mechanical Acceptance Test Technician Implementation Proceedings**. Any comments or questions may be submitted to the CEC's docket (**20-ATTCP-01**). Visit the **ATTCP web page** for more information.

1

Email Lists

Receive updates on the Energy Standards

Subscribe to the following Efficiency emails:

- Join the Building Standards email list
- Subscribe to the Blueprint

Respond to confirmation email within 24 hours

Approved Compliance Software

Used to show compliance with the Energy Code when using the performance approach

Residential

- CBECC-Res
- Energy Pro
- Wrightsoft Right-Energy

Nonresidential

- CBECC-Com
- Energy Pro

Download the compliance software

HERS Counter Card

- Available online
- Intended to assist counter staff
- Inform applicants about HERS testing and verification

Download the HERS Counter Card

Approved HERS Providers

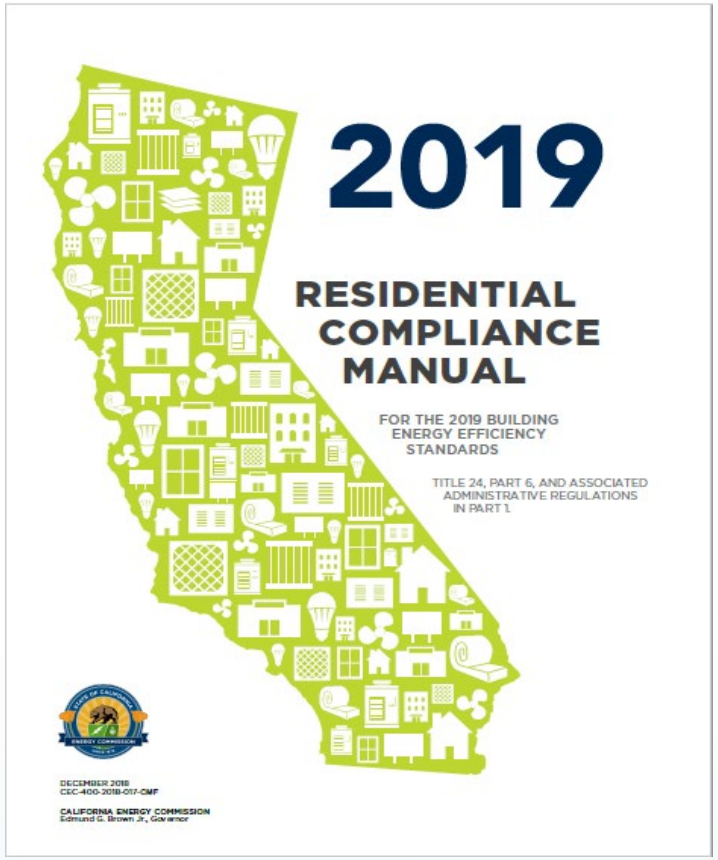
- CalCERTS - New construction, HVAC alterations, and whole house ratings
- CHEERS- New construction and HVAC alterations

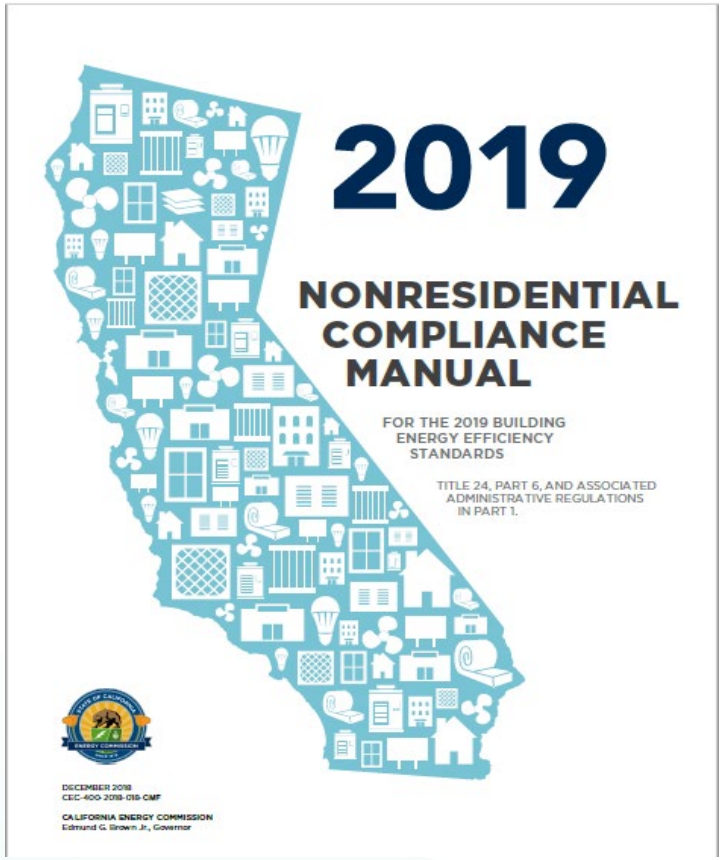
See approved HERS providers

Energy Standards Hotline

- Available to help with questions about Part 6
- Email your questions to the Hotline at title24@energy.ca.gov
- Call us!
  - 800-772-3300 from within California (toll free)
  - 916-654-5106 from outside California
  - Available 8am to 12pm, 1pm to 4:30pm

Compliance Manuals





Download the 2019 Compliance Manuals

Energy Code Ace

- Forms and resources
- Free training (in person and online)
- Checklists and trigger sheets

Don't gamble on Title 24, Part 6 and Title 20 compliance.
Ace it with:

For more Energy Code resources, visit Energy Code Ace

Questions?