FRANKLIN ENERGY™

COMFORTABLE HOME REBATES

2022 Comfortable Home Rebates

Technical Standards

For Pacific Gas and Electric Territory

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1. Introduction

Comfortable Home Rebates offers property owners incentives for participating in installing Program measures that are intended to give them greater comfort, savings on energy costs, and better indoor air quality.

This document provides a set of technical standards for energy efficiency measures and/or health and safety tasks that are required for (or eligible for) inclusion in Program projects. The standard for each measure discusses minimum requirements, best practices, and may also include verification protocols for the Technical Review verifier and Field Quality Control (FQC) verifier. The Technical Review verifier will apply the verification protocols to confirm that the minimum requirements were adequately met in 'Technical Review' (after an application has been submitted for review for incentive processing). The FQC verifier will apply the verification protocols to confirm that the minimum requirements were adequately met in the field. The quality assurance and quality control processes and the roles of the Technical Review verifier and Field Quality Control (FQC) verifier are discussed in more depth in the *Comfortable Home Rebates Improvement Pathway Participant Handbook.* [1]

[1] Comfortable Home Rebates Improvement Pathway Participant Handbook, www.comfortablehomerebates.com

Table 1. Program Measures

Name	Standard	Quantity	PG&E Fuel Required
Attic Insulation	"Effective" R-44 or better, installed per CEC QII standards.	100% of accessible attic area (minimum 50% of total attic area)	Gas and/or electric
	<1799 sq ft Conditioned Area		
	>1800 sq ft Conditioned Area		
Air Sealing	0.35 or better ACHn target, 0.5 ACHn minimum performance, achieved in accordance with BPI standards and ventilated per ASHRAE 62.2. (installation of balanced Heat Recovery Ventilation recommended)	800 square foot conditioned area (at 8 ft average ceiling height) minimum	Gas and/or electric
	< 1799 sq ft Conditioned Area		
	> 1800 sq ft Conditioned Area		
Duct Sealing	Seal existing ducts to 5% or 10% leakage or less. Total leakage or DLTO accepted to accommodate bi-levels. Add ducting where cavities have been used or seal cavities such as platform returns.	Up to 2 systems (total) per dwelling unit	Gas and/or electric
	10%		
	5%		
Duct Replacement	Replacement only; R-8 All CZs @ 5% leakage or less.	100% of accessible ducts; up to 2 systems (total) per dwelling unit	Gas and/or electric
Heat Pump Space Conditioning	15 SEER Cooling or better, 9.0 HSPF or better Heating (14.5 & 8.0 or greater for package units or other unique site conditions. Call us for unusual applications.) Must have existing AC, central or window. Propane heating does not qualify.	Up to 2 HVAC systems (total) per dwelling unit	PG&E Gas AND electric **OR** all electric homes in PG&E territory.

	Multi-Stage System (anything more than single stage)		
	16 SEER or Greater System		
	Manual J Verified	Installed equipment matches Manual J specification within 3,000 Btu rating at equipment.	
	Manual D Verified	Installed duct work matches Manual D design. .5 total SP or lower.	
	Cash for Clunkers	Old unit 10 SEER or lower	
Heat Pump Water Heater	3.24 EF / 3.09 UEF or better. Propane water heaters do not qualify.	Up to 2 DHWs (total) per dwelling unit	Gas AND electric **OR** all electric homes in PG&E territory.
Whole House Fan	Ducted and/or insulated lid design, ECM motor required, and doors that automatically seal when not in use.	Two per home, subject to sizing conditions.	Electric
Smart Thermostat	ENERGY STAR rated or proprietary to manufacturer, DR capable, customer education on use	Up to 2 per dwelling unit	Gas and/or electric
Multi-Measure Kicker (automatic based on measures selected)	Paid for every additional measure on a project. (Excludes kickers and Smart Thermostat)	No limit.	

Qualifications for different measures are dependent on PG&E provided utility services, as follows:

- **PG&E gas and electric service:** Customers qualify for all measures and may substitute electric fuel for gas fuel.
- **PG&E All electric**: All electric customers with no gas qualify for all electricity-related measures (no propane fuel appliances on the site).

- **PG&E electric only**: Customers receiving electricity from PG&E but gas from another provider (including SoCalGas) qualify only for electricity-related measures.
- **PG&E gas only:** Customers receiving gas from PG&E but electric from another provider qualify only for natural gas fuel-related measures
- **Propane:** Rebates are not available for propane fuel water heating or space heating. Fuel switching from Propane to gas or electric water heating or space heating is not allowed for rebate

Customers who receive both gas and electric service from PG&E are eligible for all the Program measures listed above. Customers who only receive one type of fuel from PG&E are eligible for rebates for any equipment selected as part of the combined measures, if PG&E supplies the fuel for it. Upgrading an existing appliance, water heater, or HVAC-equipment from gas to electric, called 'fuel-substitution', is eligible for a rebate in Comfortable Home Rebates if the customer receives both gas and electric service from PG&E. Upgrades of existing equipment must be for more efficient versions of the same type of equipment (i.e., less-efficient Central Furnace to more-efficient Central Furnace, etc.). Additionally, customers must have existing non-portable air-conditioning and/or existing non-portable electric heating if they only have PG&E electric service **or** an existing non-portable natural gas furnace if they only have PG&E gas service, regardless of whether that equipment is selected as a measure as part of a Comfortable Home Rebates incentive application.

2. Non-Incentive Program Requirements

2.1 Combustion Appliance Safety Testing

Combustion Appliance Safety (CAS) is an integral part of the Program's Improvement Pathway. The Program has adopted core CAS protocols from BPI and the PG&E *Natural Gas Appliance Test (NGAT) Action Guidelines* and the *PG&E Make Safe Procedure* to expedite gas safety calls to PG&E Gas Service Representatives. Reference PG&E's *Whole House Combustion Appliance Safety Test Procedure* for Program-specific CAS protocols. Visit the Document Library at Comfortable Home Rebates for more information on any of the above referenced documents.

- **The Customer may not waive CAS testing.**
- **If an appliance fails CAS and the failure is within work scope of the project, it should be repaired.**
    - **If the failure is outside the work scope, both the customer and GSR should be informed of the failure.**
- **If a repair is needed at or prior to the utility meter, contractors must notify the gas service provider immediately.**

CAS testing is dependent on measures being installed. All-electric projects do not require CAS testing. 2-4 Unit projects require that each unit be CAS tested. A separate CAS reporting form should be submitted for each unit.

For measures where building infiltration or pressure dynamics of the home is present (insulation, air sealing) CAS is required at time of install and when work is completed (test-in/test-out).

For all other Program measures, CAS testing should be done at **Time of Install only**. Any failures or repairs necessary should be completed on site during the project installation.

Measures that require CAS testing are defined below. To claim Duct Sealing, Duct Replacement, or Building Sealing, diagnostic Test-In should be completed, as well.

Table 2. Diagnostic and Safety Testing Requirements

Measure Installed	Conclusion of Install CAS	Blower Door Test Out	Duct Test Out
Whole Building Air Sealing	X	X	
Attic Insulation	X		
Duct Sealing	X		X
Duct Replacement	X		X
Whole House Fan	X		
Heat Pump Space Conditioning	F		
Heat Pump Water Heater	F		

Table Color Key:
X = Required
F = Required if any gas appliances still on project site, including gas furnaces.

2.1.1 Minimum Requirements

- Combustion appliance safety (CAS) testing must be conducted or supervised by a BPI-certified professional with PG&E's Make Safe Procedure. CAS testing is required at Conclusion of Install for all measures if there are any gas fuel appliances on site. See Table 2 below for a breakdown of measures that trigger testing and when. All-electric projects should still follow PG&E guidelines for leakage testing of capped gas lines.
- All CAS and CAZ (combustion appliance zone) testing must be done in accordance with the testing protocols in the Whole House Combustion Appliance Safety Test Procedure for Pacific Gas and Electric Company (PG&E) Comfortable Home Rebates Program (available at our website). Contractors must make repairs or take other corrective actions as specified in the *Natural Gas Appliance Testing (NGAT) Action Guidelines*.[2] All homes must pass CAS testing.

[2] Available at https://comfortablehomerebates.com/pge-contractors/program-documentation/

Repairs or other corrective actions (as specified in the *Natural Gas Appliance Testing (NGAT) Action Guidelines* and *Whole House Combustion Appliance Safety Test Procedure For Pacific Gas and Electric Company [PG&E]* documents) should be added to work scopes. Please manage expectations with customers accordingly.

- For buildings with 2-4 units, each unit and each CAZ must be tested, with particular attention paid to the possibility of pressure 'communication' between units.

2.1.2 Best Practices

- Focus on older appliances that need to pull air out of the house to operate safely (natural draft combustion appliances). Sealed combustion or direct-vent combustion appliances only need to be tested for ambient CO in the vicinity of the appliance if they are properly installed.
- Assumed 'All Electric' homes must still be inspected for the presence of a combustion appliance and tested for ambient CO as a precaution. They also require CO monitors as building uses can change and they can be affected by temporary CO hazards.
    1. Install 'jump ducts', transfer grills, or door undercuts to allow air to flow more freely into and out of rooms when the HVAC system is operating. If opening the door to any given room reduces the depressurization of the CAZ, this strategy can be effective. With jump ducts or transfer grills, the same improvement can be achieved without the need to leave that room's door open.
    2. Design and install two independent paths for combustion ventilation air (CVA) to reach the appliance zone directly from outdoors. Then air seal and insulate these paths, and also insulate and air seal the appliance zone itself.
    3. Enlarge the combustion appliance zone by removing obstructions like interior partitions and doors, so that air can flow freely into the zone from other parts of the house.
- Appliance replacement (from natural draft to Sealed Combustion) is usually the most practical and least expensive. It provides energy savings plus safe operation.
- If combustion appliance testing reveals that there is spillage of combustion gases (i.e., not enough flue draft pressure in the vent of the appliance), there are a few potential choices that can help remedy the issue:
    1. Replace the appliance with a modern, sealed-combustion unit.
    2. Remove and reinstall the combustion appliance outside of the home's pressure boundary (usually to the garage or attic) or entirely 'outdoors'.
    3. Add jump-ducts, transfer grills, or door undercuts between 'compartmented spaces' to reduce the pressure differences created when the HVAC system's blower is operating. (Compartmented spaces are rooms with doors, but without an air outlet to relieve pressures created by the HVAC system.)
    4. Add more CVA to the area where the appliance is located (the combustion appliance zone).
- Of these alternatives, appliance replacement with sealed combustion units is by far the preferred alternative. It saves energy through much-increased heating efficiency and provides an opportunity for further energy-saving synergies with other heating and cooling components.

2.1.3 Verification

- FQC verifiers will be assessing the effectiveness of the work performed and determine if all efforts had been made to mitigate health and safety hazards.
- Combustion safety is of utmost concern. FQC verifiers will be testing all CAZ areas as well as the appliances for combustion safety per BPI and PG&E's *Natural Gas Appliance Testing (NGAT) Action Guidelines.*

2.2 Carbon Monoxide Device

2.2.1 Minimum Requirements

- Carbon monoxide (CO) devices (alarms or detectors) are required wherever there is a CO hazard and/or dwelling unit. CO devices are still recommended for all-electric homes, especially homes with attached garages.
- As required for compliance with CA SB-183 (also known as the "Carbon Monoxide Poisoning Prevention Act"), as of July 1, 2011, all Program Single-Family Dwelling projects, regardless of necessity for building permit, must include permanent installation of at least one CO alarm/detector meeting UL-2034 (for alarms) or UL-2075 (for detectors), installed according to manufacturer's instructions (and NFPA 720) in all dwelling units intended for human occupancy. This includes 'all-electric homes', as dwelling unit uses can change or encounter temporary/event-specific CO hazards. Existing alarms/detectors less than five years old and meeting Program requirements are allowed. 2-4 Unit Dwelling projects are also required to comply (as of January 1, 2013). CO Monitors must be installed outside each sleeping area, including the basement (if applicable).
- Instructions and paperwork including service and maintenance of the unit shall be provided to customers.
- CO devices shall be replaced every five years or less.
- If the CO device is a combination battery operated (primary power source) smoke/CO alarm, the device must display the date of manufacture, provide a place where the date of installation can be written, incorporate a hush feature, incorporate an end-of-life feature

2.2.2 Best Practices

- In addition to installing CO devices outside of sleeping areas (typically in hallways near bedrooms), it is recommended that additional CO devices are installed to provide a separate detector(s) for each floor of the building, in areas with atmospherically vented appliances, in kitchens, and near doors to attached garages (see *Participant Handbook* for additional details and resources).

2.2.3 Verification

- FQC verifiers will conduct field compliance verification for installation of carbon monoxide devices.

2.3 Participant Health & Safety

2.3.1 Minimum Requirements

- All Participating Contractors and Independent Building Analysts must abide by BPI Health and Safety standards and have all the necessary personal safety equipment required by all applicable federal, state, and local laws, including, but not limited to, the "Occupational Safety and Health Standards" promulgated by the U.S. Secretary of Labor and the California Division of Occupational Safety and Health (OSHA and CalOSHA, respectively).[3] Required safety equipment includes, but is not limited to:
  - Canister-type respirators
  - Gloves
  - Protective clothing or overalls
  - Elbow and knee pads
  - Safety glasses
  - Hard hats
  - First aid kit
  - Fall arresters
- Technicians and installers must be trained on the proper use and applicability of these safety devices and adhere to all OSHA regulations when performing diagnostics or work at the site.
- All tools and machinery must be used in a safe manner and be properly maintained and/or calibrated per manufacturer's recommendations.
- Diagnosticians and installers must have in their possession all applicable GHS-compliant SDS Sheets for all materials brought on site. This includes but is not limited to:
  - Diagnostic smoke
  - Caulking and adhesives
  - Insulation and air-sealing materials
- If there is known or suspected presence of lead, mold, asbestos, or any other perceived or potentially hazardous materials found at test-in/initial assessment or at any time during or after

[3] OSHA: Code of Federal Regulations, 29 CFR, Part 1910, *Occupational Safety and Health Standards*, and Part 1926, *Safety and Health Regulations for Construction*, U. S. Department of Labor, Occupational Safety and Health Administration, www.osha.gov/pls/oshaweb/owasrch.search_form?p_doc_type=STANDARDS&p_toc_level=0 Cal/OSHA: Laws and Regulations, Department of Industrial Relations, State of California, www.dir.ca.gov/dosh/LawsAndRegulations.htm

installation, all care must be taken to ensure occupant and worker safety. Site-specific judgement should be utilized to determine whether it is safe to perform blower-door and/or duct-testing on a case-by-case basis. All applicable codes, ordinances, and guidelines must be followed.

- Training and certification in the identification, removal, disposal, abatement, and remediation of hazardous materials is outside of the scope of the Program. If any hazardous materials are encountered during the course of a project, only those Participating Contractors that have the necessary training and required certification(s) and/or license(s) may remove, dispose, abate, and/or remediate hazardous materials discovered on a job site. Participating Contractors, and/or their appropriately licensed subcontractors, shall be solely responsible for their identification, removal, disposal, abatement, and/or remediation of hazardous materials encountered on a job site. Neither Franklin Energy nor PG&E shall have any liability arising out of, resulting from, or regarding a Participating Contractor's (and/or their subcontractors') detection, identification, inspection, removal, disposal, abatement, and/or remediation of hazardous materials.

2.3.2 Best Practices

- In addition to complying with all OSHA, Cal/OSHA and all other applicable federal, state, and local laws health and safety laws and standards, program participant employees should participate in OSHA 10-Hour or 30-Hour, HAZWOPER, First-Aid, AED and/or CPR trainings (see *Participant Handbook* for additional details and resources) and update trainings regularly or as needed.

2.3.3 Verification

- FQC verifiers will conduct field compliance verification for the presence of project-site safety issues and/or hazards and may also request copies of applicable GHS-compliant SDS Sheets.

3. Program Incentive Measures

3.1 Air Sealing

An effective and continuous thermal and pressure boundary shall be established in each home through the installation of appropriate air sealing and insulation measures. Wherever possible, air sealing and insulation strategies shall be designed to align the thermal and pressure boundaries to create a single continuous thermal envelope.

Air sealing strategies shall be determined based on blower door diagnostic results, visual inspection of critical by-pass areas, and indoor air quality evaluations for each home.

3.1.1 Minimum Requirements

- All air sealing shall be performed before installation of insulation.
- The air sealing target is to get below 0.35 air changes per hour, natural (ACHn), but at a minimum, achieve 0.50 ACHn or better (lower) post-installation.
- All projects must comply with Indoor Air Quality and Mechanical Ventilation requirements in Section 4.6 of the *Residential Compliance Manual for the Building Energy Efficiency Standards*, Title 24, Part 6 [4] (including local exhaust ventilation or local exhaust ventilation and continuous mechanical whole-house ventilation in accordance with ASHRAE 62.2-2010 [CA]).
- If asbestos is present, do not test-in envelope or duct systems if asbestos is present. Abatement should be noted on the SOW/Contract and Contractor to use default calculator if Air sealing is selected as a measure. Copy of calculator should be uploaded into the application to confirm reduction was met. And a note in the application detailing why the default calculator was used.
- Whole house air sealing to reduce air infiltration shall be done in accordance with Building Performance Institute (BPI) Standards as follows:[5]
    - Air sealing measures shall be prioritized to reduce the stack effect and inhibit moisture migration into attics or other interstitial spaces.
    - Blower door quick tests should be performed during air sealing to track progress and verify results.
    - Garage to living space connections should be tested for air tightness using a smoke stick or pressure measurements in conjunction with the blower door. Air leaks between the garage and living space should be sealed as part of the work scope.
    - Attic ventilation shall not be recommended or installed without first verifying the presence of an effective air barrier and thermal barrier between the attic and the living space or specifying appropriate attic air sealing as part of the work scope.
    - Air seal communication between the attic and living space first. Areas to seal include, but are not limited to: by-passes around chimneys, ducts, drop soffits, shower inserts or other large penetrations; interior and exterior wall top-plates; and plumbing and wiring penetrations.
    - Leakage paths identified between attached or tuck-under garages and the living space must always be sealed.
    - Seal off leakage paths through interstitial building cavities using manual air sealing, high density cellulose cavity insulation (see below), or spray-foam products.
    - If the home's CFM50 is still higher than 0.5 ACHn after sealing the attic, garage, and basement, interior air sealing may be performed as needed, including: sealing around plumbing penetrations, caulking around window and door casings, caulking around molding and baseboards, or other significant leakage areas identified using the blower door.
    - Air sealing installations should be performed to be permanent improvements to the structure. Products with an expected lifespan of less than 20 years should not be used.

[4] California Energy Commission, www.energy.ca.gov/title24

[5] Building Performance Institute, *www.bpi.org/standards_approved.aspx*

- A blower door test (required for Improvement Pathway 'Test-Out' if Whole Building Air Sealing measure was selected) and combustion appliance safety (CAS) test must be performed after the installation of air sealing (each day if necessary) to ensure safety and when a mechanical ventilation system is installed in a building where combustion appliances are present. All CAS tests must include testing to meet minimum safety requirements for spillage, and CAZ depressurization.

3.1.2 Best Practices

- Although the Program target is 0.35 ACHn, a better practice is to air seal as much as possible (ideally, target 0.14 ACHn, or 3 ACH50, as a best practice) to reduce energy loss and to mitigate unwanted pollutants from entering the home. This level of effort (below 0.35 ACHn) would need to include installation of a separate 'whole building' mechanical ventilation system for the home per ASHRAE 62.2, which would provide enough ventilation air for the occupants due to a tighter building envelope. As a best practice, this would be a balanced or Heat Recovery Ventilation (HRV) system with high-efficiency Electronically Commutated Motor (ECM) driving the fan. Customers should be made aware of this potential outcome. Although this strategy may intuitively seem in contradiction to logic and program goals (i.e., saving energy), the research has shown that most often tighter structures with high-efficiency mechanical ventilation systems save more energy than leaky structures without mechanical ventilation.
- Even when the building envelope is not sealed below 0.35 ACHn or an addition of conditioned living area does not trigger required installation of continuous mechanical ventilation per ASHRAE 62.2-2010 (CA), it would be a best practice to provide continuous mechanical ventilation anyway, ideally utilizing balanced mechanical ventilation via an HRV system.
- Zonal pressure diagnostic testing should be performed to identify those areas of the structure that have the most air leakage. Typically, the high areas of the home (ceiling plane of top floor) have the most cost-effectiveness due to the "stack-effect" (heat rising and leaving the structure). Penetrations in the ceiling plane, including light fixtures, exhaust fans, speakers, and attic hatches, should be sealed as accessible with the appropriate materials. Non-insulation rated recessed light fixtures could/should be replaced with ICAT (insulation contact, air-tight) type fixtures. If insulation is to be added on top of, and/or otherwise in-contact with, recessed light fixtures, non-insulation rated recessed light fixtures shall be replaced with ICAT recessed light fixtures.
- Air sealing around vent stacks and chimneys may need special care. Some of these pipes and vents can get very hot, and therefore, only heat resistant materials should be utilized, including heat-resistant caulking and/or foam sealants that are rated for this purpose.
- Consider low-VOC content materials whenever possible for the health of your crews and the occupants.

Using Insulation for Air Sealing:

- Where leakage paths are identified that cannot be accessed or reasonably sealed using conventional air sealing techniques or foam insulation can be installed strategically to reduce airflow through the building shell.

- Fiberglass insulation is not an air barrier and may never be used as an air sealing material.

3.1.3 Verification

- Technical Review will include confirmation of work-scope and photo documentation of pre- and post-upgrade building leakage testing results (manometer photos). The contractor shall report test-in and test-out blower door results for appropriate building leakage reduction measure targets to the Program in CFM_{50}.
- The FQC verifier's test results should be within rounding error (0.5 percent) of the reported test-out (post-upgrade) numbers.
- FQC verifiers will be assessing the effectiveness of the work performed and determine if all reasonable efforts had been made to mitigate accessible uncontrolled infiltration and to provide mechanical ventilation (as needed or required).

3.2 Attic Insulation

Prior to installing insulation in an existing home, a thorough inspection of the interior and exterior of the home is required to identify areas where installation of insulation may be unsafe. Problem areas include: areas with knob-and-tube wiring, recessed light fixtures, areas where moisture is present or suspected, and structurally unsound building elements (e.g., suspended acoustical tile ceilings, wood paneling). Problems that are identified must be communicated to customers in writing and should be remedied prior to insulating.

3.2.1 Minimum Requirements for Insulation

- Installed insulation must be new material, installed to R-44 or better and meet or exceed all applicable local, state and federal standards and code requirements.
- Insulation must be installed in the attic and/or thermal boundary of the conditioned living area.
- CAS and Blower door testing shall be performed whenever insulation, air sealing, or ventilation is installed to confirm safe conditions for the occupants.
- Newly installed insulation must benefit the occupant(s). Insulation should be installed between a conditioned living area and all-accessible unconditioned non-living area. Installing insulation in building assemblies with minimal or no potential for heat transfer (i.e., garage ceiling to vented attic, interior ceiling [1st story] to interior floor [2nd story], etc.) does not qualify.
- Materials shall comply with, and be installed in conformance with, all applicable local, state and federal building and fire codes, including, but not limited to, compliance with flame spread rating and smoke density requirements of Title 24, Part 2, Chapter 7, Section 720, Thermal- and Sound-Insulating Materials.[6]

[6] California Building Standards Commission, *California Building Standards Code: California Code of Regulations Title 24,* www.dgs.ca.gov/BSC/Codes

- **Insulation shall not be installed where live knob-and-tube wiring exists.** Upgrade wiring to current standards before insulating.
- Materials shall be certified to be compliant with California insulation quality standards, as listed in the current *Directory of Certified Insulation Materials*.[7]
- All attic access openings, including doors, hatches, and pull-down stairs shall have a tightly fitting cover which is insulated to a minimum R-30 (preferably, the same R-value as the upgraded attic insulation). Permanently attach rigid foam or batt insulation to the access door using adhesive or mechanical fastener. The bottom of the attic access shall be properly gasketed to prevent air movement.
- R-values of installed insulation shall be determined based on an actual measurement of the insulation depth and the R-value per inch for that product. Refer to *Building Performance Institute Technical Standards for the Building Analyst Professional* for typical insulation R-values and effective R-values for batt insulation.[8] Voids in insulation must be accounted for by determining the net square footage of uninsulated area and recording it as a separate building assembly/component orientation of the building.
- Insulation shall cover all recessed lighting fixtures. If recessed light fixtures are not rated for insulation cover (IC) and air tight (AT), the fixtures should be replaced.
- All recessed light fixtures that penetrate the ceiling shall be IC (insulation contact) and AT (air tight) rated and shall be sealed with a gasket or caulk between the housing and the finished surface, or, if not IC rated, recessed light fixtures must be 'boxed-in' with approved fire-rated materials (i.e., fire-rated drywall 'boxes', "fire-boxes", etc.) and air-sealed with fire-rated caulk or blocked with non-combustible material to maintain safe clearance to insulation. Other heat-producing devices must be ICAT rated or high-efficiency ECM motor-driven so that it will not get hot enough to be eligible to be IC tested and listed, per manufacturer equipment documentation. Chimneys, flues, and other "hot vents" must also be baffled with an effective non-combustible dam or blocking prior to insulating to maintain a safe clearance to the insulation being installed. Refer to Title 24 for specific clearance requirements, and consult local code enforcement for any additional clearance requirements.
- Single-walled flue pipes require a minimum 6-inch clearance to insulation or other combustible materials. Refer to NFPA 54 for additional requirements for specific chimney materials. Hard covers or draft stops shall be placed over all drop ceiling areas and interior wall cavities to keep insulation in place and stop air movement. If hard covers or draft stops are missing or incomplete, they shall be completed before insulation is installed.
- Required eave ventilation shall not be obstructed—the 'net-free' ventilation area of the eave vent shall be maintained. Eave vent baffles shall be installed to prevent air movement under or into the insulation.
- Follow local code with respect to attic ventilation, **especially in fire-prone areas of the state.**
- Materials shall be installed according to manufacturer specifications and instructions.

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[7] State of California Department of Consumer Affairs, *Consumer Guide and Directory of Certified Insulation Material,* bhgs.dca.ca.gov/industry/thermal_insulation.shtml

[8] Building Performance Institute, www.bpi.org/standards_approved.aspx

- Protect the installing crews by providing safety gear (dust masks and protective clothing), ample light, and fresh air to the space they are working in.

3.2.2 Best Practices for Attic Insulation

- Air sealing (all accessible areas) should be performed before insulation is installed.
- Installation of insulation should be done in accordance with Building Performance Institute (BPI) Standards[9] and California Quality Insulation Installation Standards (QII), as specified in the Building Energy Efficiency Standards Reference Appendices, Section RA3.5.[10]
- To prevent deficiencies in the thermal boundary (insulation layer), it is considered best practice to refrain from batt-type insulation products in the attic, above the ceiling plane. It is recommended to use blown-in products such as blown-in fiberglass or cellulose.
- All care should be taken to minimize dust and insulation materials from entering the living space. There are different ways to resolve this; one is to create separate entrances into the attic space outside of the living space such as through a gable-end vent or skylight shaft or, if that is not possible, at least keep a controlled pathway through the home that minimizes dust transfer into living space. Another strategy is to positively pressurize the living space to prevent migration of dust particles into the living space.
- Attic insulation should not be recommended or installed without first verifying the presence of an effective air barrier between the attic and living space or specifying appropriate attic air sealing as part of the work scope. To evaluate the effectiveness of the attic-to-living space air barrier, various techniques can be used such as:
    - Pressure differential diagnostics, series leakage tests, and “add a hole”.
    - Visually inspecting the attic floor underneath the insulation layer to locate air bypasses and cavities.
    - Inspecting the current insulation material for signs of infiltration (soot-blackened).
    - Using a smoke stick with a blower door running in the conditioned space to see if the smoke is drawn down into the living space.
    - Reversing the blower door (pressurizing) and conduct Infrared investigation from the attic-side of the ceiling to see if heat transfer is occurring.

If there is air movement identified by one of the above methods, those areas should be addressed as part of the work scope prior to insulation being installed.

- Attic crawl space should be adequate (ideally, 24 inches or more between the bottom of the roof rafter and the top of the ceiling joists) and accounted for, depending on the type of insulation being installed.

When requested or available, specify environmentally preferable materials:

[9] Building Performance Institute, www.bpi.org/standards_approved.aspx

[10] California Energy Commission *Reference Appendices for the Building Energy Efficiency Standards, Title 24, Part 6*, www.energy.ca.gov/title24

- **Cellulose, Cotton, Wool:** Minimum 75 percent post-consumer recycled content as recommended by EPA's Recovered Materials Advisory Notice (RMAN) [11] *and* demonstrated low-emitting as defined by California's Section 01350.[12]
- **Fiberglass:** Minimum 20 percent recovered (pre or post-consumer recycled) content as recommended by EPA's Recovered Materials Advisory Notice (RMAN) *and* demonstrated low-emitting as defined by California's Section 01350.
- **Spray Foam:** Demonstrated low-emitting as defined by California's Section 01350. Recommended minimum five percent recovered (pre-or post- consumer) recycled content or agriculture- based content as recommended by EPA's Recovered Materials Advisory Notice (RMAN).

3.2.2.1 *Standards for Insulating Knee walls*

- All knee walls and skylight shafts should be insulated to a minimum of R-19. If loose-fill insulation is used, it shall be properly supported with netting or other support material. An air barrier is required on the attic side of a knee wall, covering the insulation.
- The insulation should be installed without gaps and with minimal compression.
- The house side of the insulation should be in continuous contact with the back of the drywall (air barrier) or other wall finish.
- The insulation shall be supported so that it will not fall down by either fitting to the framing, stapling in place with minimal compression.
- Walls of interior closets for heating ventilation and air conditioning (HVAC) and/or water heating equipment, which require combustion air venting, should be insulated to the same R-value as the exterior walls and must be weatherized/air stripped.
- Insulation installed in knee-walls or other exposed vertical areas within an attic must be covered on the cold side with an air barrier such as ½-inch plywood, 5/8-inch drywall, FSK, or other air-sealing, fire-rated material to protect the insulation from wind-washing and prevent convection within the insulation. This measure is not necessary if rigid foam insulation is used. Local codes might also require fireproofing of those vertical surfaces on the attic side.

3.2.2.2 *Standards for Batt Insulation*

- Batt insulation should be installed at full loft with the insulation in full contact with the warm side of the building surface. Gaps between the insulation and the building elements must be avoided. Insulation batts should not be compressed, folded, tucked, rolled, or otherwise compromised when installed for insulation purposes.

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[11] Environmental Protection Agency, *Comprehensive Procurement Guidelines for Construction Projects*, www.epa.gov/smm/comprehensive-procurement-guidelines-construction-products

[12] CalRecyle, Green Building Special Environmental Requirements, *Section 01350*, www.calrecycle.ca.gov/greenbuilding/specs/section01350 and California Department of Public Health, *Indoor Air Quality (IAQ) Section*, www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/VOC.aspx#material

- Batts should be correctly sized to fit snugly at the sides and ends. Batts should be installed so that they will be in contact with the air barrier. Where necessary, batts should be cut to fit properly - there should be no gaps, nor should the insulation be doubled-over or compressed.
- Batts shall be cut to butt-fit around wiring and plumbing, or be split (delaminated) so that one layer can fit behind the wiring or plumbing, and one layer fit in front.
- For batts that are taller than the trusses, full-width batts should be used so that they expand to touch each other over the trusses.

3.2.2.3 *Standards for Loose-Fill Ceiling Insulation*

- Insulation should be blown to a uniform thickness throughout the attic at appropriate air pressure and material quantity (depth and/or weight) to ensure complete coverage and manufacturer's recommended density to achieve the prescribed R-value without voids, gaps, or settling in enclosed cavities. Insulation should be applied all the way to the outer edge of the wall top plate.
- Attic rulers appropriate to the material installed shall be evenly distributed throughout the attic to verify depth: one ruler for every 250 square feet and clearly readable from the attic access in all directions. The rulers shall be scaled to read inches of insulation and the R-value installed.
- Insulation should be applied underneath and on both sides of obstructions such as cross-bracing and wiring.

3.2.2.4 *Standards for Spray Foam Insulation*

Spray foam insulation (SPF) increases thermal performance and reduces air infiltration significantly. SPF insulation has a number of application-specific requirements. When it is used, all work should conform to California regulations as specified in Building Energy Efficiency Standards Reference Appendices, Section RA3.5.6: [13]

- SPF insulation should be spray-applied to fully adhere to the substrate (roof deck or ceiling).
- SPF insulation should be spray-applied to fully adhere to the joist and other framing faces to form a complete air seal within the construction cavity.
- SPF insulation should be installed in a continuous and fully adhered manner to form an air barrier.
- SPF insulation should be spray-applied to fully adhere to and seal around wiring and plumbing.
- SPF insulation should not be applied directly to recessed lighting fixtures. Recessed light fixtures that are not insulation contact (IC) rated should either be replaced or eliminated. If they are not replaced or eliminated, they may be covered or 'boxed-in' if they meet the criteria in Building Energy Efficiency Standards Reference Appendices, Section 3.5.6.3.

[13] California Energy Commission *Reference Appendices for the Building Energy Efficiency Standards, Title 24, Part 6*, www.energy.ca.gov/title24

HVAC Platform

- A minimum of 3 inches of SPF insulation should be placed below any plywood platform or cat-walks installed in vented attics for HVAC equipment and access to assure that the overall assembly meets the required insulation values listed in the compliance documentation.
- SPF insulation should be installed in a continuous and fully adhered manner to form an air barrier.

Attic Access

- Apply a minimum of 3 inches of SPF insulation to the access door or permanently attach rigid foam with adhesive or mechanical fastener to assure that the overall assembly meets the required values specified in the Compliance Documentation.

Attics and Cathedral Ceilings

- Prior to installation, verify that the building official in your area permits SPF insulation directly applied to the underside of the roof.
- SPF insulation shall be kept away from combustion appliance flues in accordance with flue manufacturers' installation instructions or labels on the flue for clearance.
- In unvented-conditioned attics where entry is made for the service of utilities, SPF applied in direct contact with the underside of the roof deck shall be protected from ignition in accordance Building Energy Efficiency Standards Reference Appendices, Section RA3.5.6. [14]
- In cathedral ceilings where restricted spaces do not allow entry, SPF insulation does not require protection from ignition.

3.2.3 Verification

- Technical Review will include confirmation of work-scope.
- Field QC verifications will include visual verification of installed levels and presence/location of rulers and may include invoice review and/or measuring random points within the attic and comparing installed levels to insulation charts showing R-values for the different types of insulation.
- The location of insulation and how well it serves the occupants will be assessed.
    - Insulation installed in areas with no comfort or energy saving benefit does not qualify.
- Attic access hatches shall also be evaluated for their insulation effectiveness.

[14] California Energy Commission *Reference Appendices for the Building Energy Efficiency Standards, Title 24, Part 6*, www.energy.ca.gov/title24

3.3 Duct Replacement

3.3.1 Minimum Requirements

- Installation of new ducts shall comply with Title 24, Chapter 6, Building Energy Efficiency Standards, including requirements for duct insulation, duct sealing, and third-party inspection by a certified HERS Rater. Duct leakage shall not exceed 5% of nominal or actual system air flow. Verification must be done using procedures defined in Appendix RA3 of California Energy Commission's Reference Appendices for the California Building Energy Efficiency Standards, Title 24, Part 6.[15]
- Home must be served by an existing central air conditioner, furnace, or heat pump; new systems installed when no prior equipment was present will not qualify, since state building code already requires a duct test on these systems.
- Individual cooling systems must be between 1.0- and 5.0-tons capacity. Air conditioning systems with multiple compressors and economizers are not eligible. Up to two (2) systems at the same address are eligible in the Program.
- Ducts must be replaced and sealed in accordance with the requirements contained in the 2019 Residential Compliance Manual for the Building Energy Efficiency Standards, Section 4.4, "Air Distribution System Ducts, Plenums, Fans, and Filters" [16] and applicable BPI Standards.[17]
- When quantifying duct leakage, an appropriate type of measurement system shall be used that includes a metered and calibrated duct pressurization device. Duct leakage shall be measured and documented any time that duct replacement is part of the work scope to verify the success of the installation.
- Duct replacement must comply with or exceed code requirements and utilize the same test measurement methods (nominal or actual, and total leakage or leakage to outside) for test-in and test-out.
- Sheet metal and flexible ductwork shall be sealed at all duct connections using duct mastic or similar product designed for sealing ducts. 'Duct tape' is not an allowable duct sealing material. UL 181B certified tape may be used on metal to metal components and at the connections and only when five overlapping turns exist, butyl backed tape can be used on plenum connections to the air handler cabinet. Mastic on the inside and outside of all connections is preferred (and lots of it)! Metal to metal connections shall have three mechanical fasteners. Panduit type straps

[15] California Energy Commission *Reference Appendices for the Building Energy Efficiency Standards, Title 24, Part 6*, www.energy.ca.gov/title24

[16] California Energy Commission *Reference Appendices for the Building Energy Efficiency Standards, Title 24, Part 6*, www.energy.ca.gov/title24

[17] Building Performance Institute, *Current BPI Standards, www.bpi.org/standards/current-standards*

shall be applied and secured using appropriate tools on both the inner and outer liners of flex duct.

- CAS testing and blower door shall be performed whenever insulation, air sealing of shell or the ducts, or ventilation is installed to confirm safe conditions for the occupants.
- When asbestos is present abatement should be noted on the SOW/Contract as well as Full Duct replacement with R-8 Ducting and sealing of 5% or better. Do not Test-in.
- When heating ducts are located outside the building envelope or cooling ducts are located in attic spaces, they should be sealed underneath the duct wrap, at all accessible connections with duct mastic, and insulated to a minimum R-8 as part of the work scope.
- If at all possible, drop ducts to the attic floor and deep bury.

3.3.2 Best Practices

- Ducts should be designed in conformance with ACCA Manuals J, D, S & T. Distribution systems should be sized according to the amount of air delivery required to each location, and duct runs should be as short as possible. Main supply trunk velocities should be designed to deliver 700 – 900 feet per minute (FPM). Branch supply ducts should be designed for 500 – 700 FPM. Minimize friction by designing systems with round duct systems and transfer to rectangular ducts minimally and with a transition piece in-between square to round. Duct System Replacement is required for projects also seeking to claim the Ultimate Comfort/HPHI measure on a project.
- To avoid polluted air migration through the distribution system, avoid installing return grills in bathrooms and kitchens. Make sure combustion zones are not affected by equipment operation.
- Avoid delivering conditioned air to very small rooms such as hall bathrooms or pantry. The room would most likely overheat/cool when the system is operating.
- Measure the temperature rise/drop of air moving across the HVAC system to ensure that it falls within manufacturer specifications.
- Pressure balance of the duct system: Any pressures created within any part of the building should not to exceed 3 Pascals of pressure (positive or negative) with reference to the outdoors, and temperature differences should not exceed 5 degrees Fahrenheit (positive or negative) from room-to-room when the HVAC system is running. Correct any zonal pressure differentials that create air leakage from the garage or other potentially contaminated zones into the house.
- Minimize conductive losses/gains through the distribution system:
    - Drop ducts to the attic floor & bury the ducts under the insulation layer.
    - Duct insulation shall be R-8 or greater.
    - Duct surface area should be minimized by shortening ducts whenever possible.
    - Run supply ducts to the closest corner of each room and minimizing the number of supply registers.
    - Plenums should be wrapped with fiberglass duct insulation or rigid insulation board.
- Strive for duct leakage near zero. The target for all new duct systems is to make them as tight as possible to both save energy and maintain performance. Brand new systems should be able to keep leakage below 50 cfm in the complete system with careful quality and craftsmanship.

- Seal take-off connections to register boots and boot connections to floors, walls, and ceilings.
- Flex ducts should be pulled as tight as is feasible to minimize static pressure and maximize heating and cooling capacities.
- Other static pressure design considerations should be implemented whenever possible like installing low pressure fittings, filters, and register grills.

Test the duct system (TDL and/or DLTO at CFM25) at initial installation completion, make air-sealing, supply air-flow, and pressure balance adjustments as needed, then re-test the system.
Use the following checklist from BPI's Shell Standards as a guide for prioritizing duct sealing during installation of replacement duct system:

- Seal the largest leaks first. These include disconnected ducts, missing end-caps, and other catastrophic failures.
- Seal the areas of highest pressure. These include all the connections near the air-handler cabinet and supply and return plenums, flexible canvas plenum connectors, and filter slot covers.
- Seal return leaks that may contribute to negative pressures in the combustion appliance zone.
- Seal all accessible connections between duct sections, at branches, and where take-offs connect to main trunk line.

Pressure imbalances may be corrected by:

  - Adding/enlarging a return air duct. Consider adding a return air duct or enlarging an existing return to areas where occupants complain of discomfort or erratic temperatures.
  - Undercutting doors to relieve pressures. A one inch undercut of a door is often the easiest and most cost-effective solution.
  - Installing balancing grills through the wall.
  - Installing a jumper duct from the room to the main living area.

- The new duct system should be placed strategically to avoid over-heating or cooling. This might require moving a system from an attic to a crawl space area, if it makes sense to do so, based on budget, performance enhancement, and delivery potential, and/or thoroughly air-sealing and deep-burying in insulation.

- Consider installing high-performing/commercial-style diffusers and grills for better, higher-velocity delivery and performance. These grills must be carefully selected and should be located at or near interior walls to keep duct runs shorter and straighter. They should have minimal interference within them (no or few dampers) and deliver air across the room to induce convective currents. Never blow delivered air on the occupants - above a headboard of the master bed for example.

Bigger area at the return grill is a benefit to the system, but avoid increasing return air duct sizes too much, due to increased duct surface area being exposed to unconditioned air temperatures, which increase heating and/or cooling loads.

3.3.3 Verification

- Technical Review will include confirmation of work-scope.
- FQC verification will include visual inspection, duct leakage testing at 25 Pascals (via the testing method contractor used for reporting – TDL or DLTO), and/or review of invoice.
- For testing total duct leakage (TDL), procedures will follow CEC protocols in the Building Energy Efficiency Standards Reference Appendices RA3.1.4.3.1.
- For testing duct leakage to outside (DLTO), procedures will follow CEC protocols in the Building Energy Efficiency Standards Reference Appendices RA3.1.4.3.4.
- The location of duct sealing efforts will be evaluated to determine effectiveness and ensure that all efforts had been made to eliminate air leakage out of the distribution system.
- FQC verifiers will also be checking specifically for zero percent leakage on the return-side of the system, if it is sharing space with other combustion appliances.

3.4 Duct Sealing

3.4.1 Minimum Requirements

- For the "Seal Ducts to 5% Leakage or less" measure, improved duct leakage shall not exceed 5% of nominal or actual system air flow.
- For the "Seal Ducts to 10% Leakage or less" measure, improved duct leakage shall not exceed 10% of nominal or actual system air flow.
- Home must be served by an existing central air conditioner, furnace, or heat pump; new systems installed when no prior equipment was present will not qualify, because state building code already requires a duct test on these systems (and adding new equipment/systems would not be an 'upgrade of existing').
- Ducts must be sealed in accordance with the requirements contained in the 2019 Residential Compliance Manual for the Building Energy Efficiency Standards, Section 4.4, "Air Distribution System Ducts, Plenums, Fans, and Filters" [18] and applicable BPI Standards.[19]
- When quantifying duct leakage, an appropriate type of measurement system shall be used that includes a metered and calibrated duct pressurization device.
- If asbestos is present abatement or encapsulation should be noted on the SOW/Contract with 5% or 10% sealing. Do not test-in.
- Duct sealing must comply with or exceed applicable code requirements and utilize the same test measurement methods (nominal or actual, and total leakage or leakage to outside) for test-in and test-out.
- Sheet metal and flexible ductwork shall be sealed at all duct connections using duct mastic or similar product designed for sealing ducts. 'Duct tape' is not an allowable duct sealing material.

[18] California Energy Commission *Reference Appendices for the Building Energy Efficiency Standards, Title 24, Part 6*, www.energy.ca.gov/title24

[19] Building Performance Institute, *Current BPI Standards, www.bpi.org/standards/current-standards*

UL 181, UL 181A or UL 181B certified tape may be used, typically on duct board systems components and at the connections to and/or on the air handler cabinet. Mastic is preferred (lots of pookey)!

- When heating ducts are located outside the building envelope or cooling ducts are located in attic spaces, they should be sealed underneath the duct wrap, at all accessible connections with duct mastic, and insulated to a minimum R-8 (supplemented with cavity insulation, as applicable) as part of the work scope.

3.4.2 Best Practices

Test the duct system (TDL and/or DLTO at 25 pascals at initial installation completion; make air-sealing, supply air-flow, and pressure balance adjustments as needed; then re-test the system.

Use the following checklist from BPI's Shell Standards as a guide for prioritizing duct sealing during installation of replacement duct system:

- Seal the largest leaks first. These include disconnected ducts, missing end-caps, and other catastrophic holes.
- Seal the areas of highest pressure. These include all the connections near the air-handler cabinet and supply and return plenums, flexible canvas plenum connectors, and filter slot covers.
- Seal return leaks that may contribute to negative pressures in the combustion appliance zone.
- Seal all accessible connections between duct sections, at branches, and where take-offs connect to main trunk lines.

3.4.3 Verification

- Technical Review will include confirmation of work-scope.
- FQC verification will include visual inspection, duct leakage testing at 25 Pascals (via the testing method contractor used for reporting – TDL or DLTO), and/or review of invoice.
- For testing total duct leakage (TDL), procedures will follow CEC protocols in the Building Energy Efficiency Standards Reference Appendices RA3.1.4.3.1.
- For testing duct leakage to outside (DLTO), procedures will follow CEC protocols in the Building Energy Efficiency Standards Reference Appendices RA3.1.4.3.4.
- The location of duct sealing efforts will be evaluated to determine effectiveness and ensure that all efforts had been made to eliminate air leakage out of the distribution system.
- FQC verifiers will also be checking specifically for zero percent leakage on the return-side of the system if it is sharing space with other combustion appliances.

3.5 Heating Pump Space Conditioning

3.5.1 Minimum Requirements

- All equipment replacement must **exceed** Title 24, Chapter 6, Building Energy Efficiency Standards, including requirements for ducts sealing, setback thermostat, refrigerant charge verification, minimum cooling coil airflow, and requirements to conduct a complete system third-party inspection by a certified HERS Rater.[20]
- All replacement equipment and ducts should ideally be properly sized according to ACCA Manuals J, D, S and T at a minimum, with specific room-by-room load calculations. Air conditioning evaporator coils and condensing units **must be** properly matched according to ACCA Manual S so that they can deliver the rated efficiency.[21]
- At the conclusion of projects for buildings with 2-4 units, all heating and domestic hot water appliances for all units must be either (1) power vented or closed combustion, (2) moved outside the building shell (including garages and attics), or (3) sealed off from the living space such that there is adequate combustion air and combustion gases are appropriately exhausted. This is true whether or not each unit participates in the Program.
- Heat-Pump systems must meet or exceed the following minimum performance standards in Table 2 (below):

Table 3. Improvement Pathway HVAC (minimum) Performance Standards*

	SEER	HSPF
Packaged central AC	14.5	8.0
Split Heat-Pump/AC	15	8.5

Franklin Energy will consider projects with a robust scope of work that cannot achieve these ratings due to conditions like packaged central units and downflow applications. Please contact your representative to review project details before determining that a customer is not able to participate. This is especially true with projects that feature a combination of dramatically improved duct systems, shell measures, and water heating.

[20] California Energy Commission *Reference Appendices for the Building Energy Efficiency Standards, Title 24, Part 6*, www.energy.ca.gov/title24

[21] Air Conditioning Contractors of America, *Manual J Residential Load Calculation*, *Manual D Residential Duct Systems, Manual S Residential Equipment Selection* and *Manual T Air Distribution Basics for Residential Buildings,* https://www.acca.org/standards/ansi#ansi

3.5.2 Best Practices

- When installing a new HVAC system, always try to locate it in an area not subject to extreme temperatures (attics) and look for locations that are central that will require shorter, straighter duct runs.
- Insertion of high resistance filters could add extraneous static pressure to the system unless it has been designed to accommodate such filters. For best performance, filter pressure drop should not exceed 0.05 inches of water column.
- Systems should be designed to utilize filters rated MERV 13, which may mean increasing return size to accommodate increased filter thickness and maintain appropriate static pressure. If the return size cannot be adjusted, use the filter size that best delivers idea static pressure.
- Thermostats may be proprietary to the manufacturer system.

3.5.3 Verification

- Technical Review will include confirmation of work-scope and AHRI certificate.
- FQC verification will include visual inspection of equipment and/or review of invoice, as well as requesting a copy of inspector-signed HVAC permit 'final'.
- System airflow measurement will be performed, if used for duct leakage calculation.
- CAS testing will be performed on gas appliances.

3.6 Heat Pump Storage Water Heaters

3.6.1 Minimum Requirements

- Replacement of domestic hot water (DHW) systems shall comply with Title 24, Chapter 6, Building Energy Efficiency Standards[22] (including domestic water Pipe Insulation) and shall meet or exceed ENERGY STAR standards when applicable.
- Minimum equipment efficiency ratings are as follows:
    - 3.24 EF / 3.09 UEF or better for Electric (Heat-Pump) Storage Water Heater
- Fuel switching from propane or other non-CPUC regulated fuel is prohibited.
- Electric resistance water heaters qualify for rebated replacement.
- Install per manufacturer's specifications.
- At the conclusion of projects for buildings with 2-4 units, all heating and domestic hot water appliances for all units must be either (1) power vented or closed combustion, (2) moved outside the building shell (including garages and attics), or (3) sealed off from the living space such that there is adequate combustion air and combustion gases are appropriately exhausted.

[22] California Energy Commission *Building Energy Efficiency Standards, Title 24, Part 6*, www.energy.ca.gov/title24

This is true whether each unit participates in the program.

3.6.2 Best Practices

- Seek the highest feasible Energy Factor within budget.
- Size the unit based on occupancy potential and recovery times.
- Insulate all accessible pipes per current standards (or better), as specified by Title 24, Part 6.
- Install thermostatic control shower valves and/or thermostatic control tub-spout diverters whenever possible.
- Install low-flow shower valves (e.g., WaterSense labeled products) whenever possible.
- Install structured plumbing systems to minimize pipe length and increase delivery performance.
- Electric Heat Pump Water Heaters should be set to Eco or Energy Saver mode.

3.6.3 Verification

- Technical Review will include confirmation of work-scope and photo documentation of existing and upgraded equipment (nameplates and 'installed location context' photos).
- FQC verification will include visual inspection of equipment and/or review of invoice.

3.7 Whole House Fan

3.7.1 Minimum Requirements

- Ducted and/or insulated lid design
- ECM motor required
- Doors must automatically seal when not in use
- Electrical service circuits shall meet all current code requirements

3.7.2 Best Practices

- Insulation dams should be installed
- Size fans appropriate for conditioned area served
- Control systems shall be appropriate to usage case
- Adequate discharge ventilation shall be confirmed prior to installation

3.7.3 Verification

- Field verification shall include
  - System sizing

- Controls for usage case
- Adequate attic ventilation area (ie gables large enough)

3.8 Smart Thermostat

3.8.1 Minimum Requirements

- Thermostat upgrade must replace existing programmable (non-'Smart') or non-programmable thermostat with an Energy Star certified, Wi-Fi-enabled Smart Thermostat.
- Wi-Fi-enabled Smart Thermostat shall demonstrate Wi-Fi connection at installation, confirmed via test login.
- Submit photos of existing/original thermostat, as well as photos of new Smart Thermostat at installation location and confirmed Wi-Fi login with each project that Smart Thermostat upgrade measure is claimed on.
- Up to two Smart Thermostats may be claimed for a single zoned system HVAC unit.
- ENERGY STAR rated or OEM proprietary to system (must be web connected).
- Customer must be educated on programming modes, best practices for pre-cooling, and TOU rates.

3.8.2 Best Practices

- Follow manufacturer's installation instructions for location of Smart Thermostat, taking into account the number of HVAC zones/systems in each dwelling unit.
- Make sure the customer has WiFi.

3.8.3 Verification

- Technical Review will include confirmation of work-scope and photo documentation, including confirmed Wi-Fi login photo or screenshot.
- FQC verification will include visual inspection of equipment and/or review of invoice.